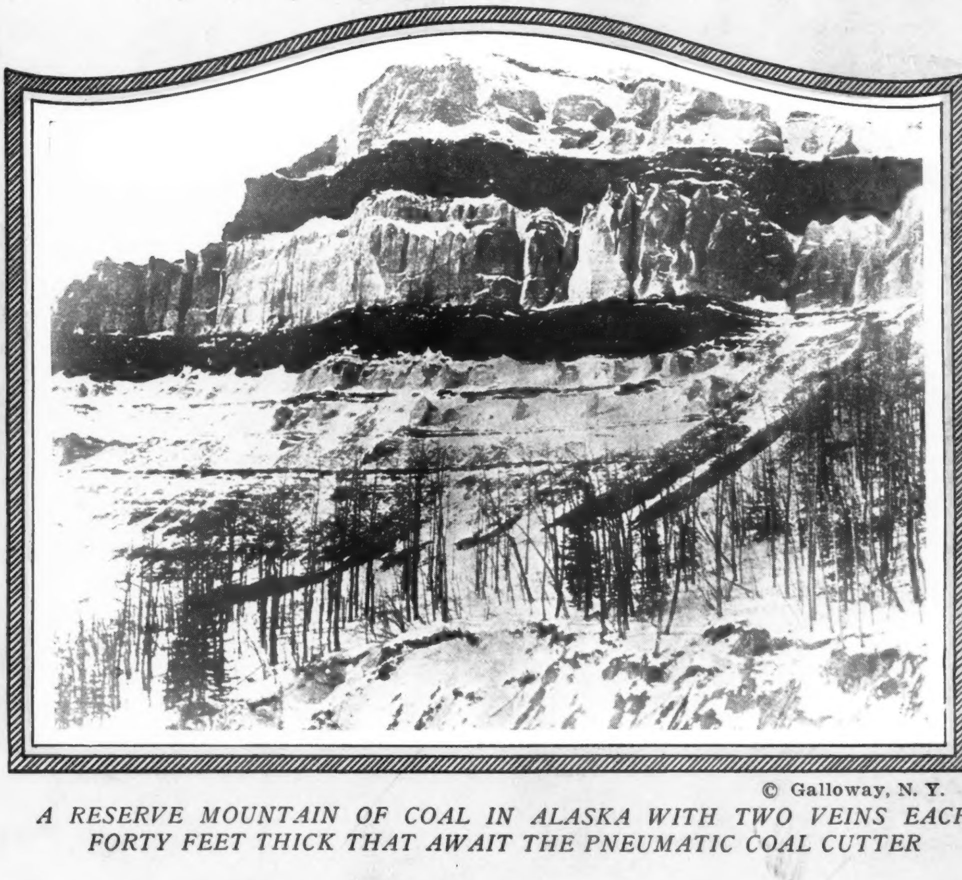
Compressed Air Magazine

Vol. XXVI, No. IV London New York Paris 35 Cents a Copy

APRIL, 1921



© Galloway, N. Y.

A RESERVE MOUNTAIN OF COAL IN ALASKA WITH TWO VEINS EACH FORTY FEET THICK THAT AWAIT THE PNEUMATIC COAL CUTTER

[TABLE OF CONTENTS AND ADVERTISERS' INDEX. PAGE 5]

BAKER COOLER

(PATENTED)

The Standard Machine for Cooling Chemical and Metallurgical Calcines

"IT FLOATS"

Derives its HIGH COOLING EFFICIENCY from Vaporization of water from the shell. Its small openings insure DUSTLESS OPERATION. Low speed and water borne weight cause LOW POWER AND UPKEEP COSTS. Cooling by Vaporization results in the MINIMUM WATER REQUIREMENT.

USED BY SUCH CONCERNS AS:

General Chemical Company	**Norton Company**
American Smelting & Refining Co.	**Empire Zinc Company**

THE STEARNS-ROGER MFG. CO.

Engineers, Manufacturers and Contractors **DENVER, COLORADO**

The meter that meets the needs of today

WHAT DOES IT COST?

6 feet of air is one horse-power. You know your cost per horse-power year. You then only need find how much your air operated devices actually consume.

THE TOOL-OM-ETER

Gives you the answer. Shows AT A GLANCE how much air is used by your sluggers, guns, jacks, japs, giants, rammers, riveters, motors, etc.—when they are new, after a month, three months, before and after overhauling and putting in new parts. Enables you to locate and remove leaks, losses and "air eaters" and to keep your equipment in eective and economical working condition. You can stop losses, decrease costs and increase your output with the same compressor capacity.

EXAMPLE:—Power cost \$75 per H.P. year. Air drill consumes 60 feet a minute by meter.

$$\frac{60}{6} \times \$75 = \$750 \text{ a year (for one tool)}$$

It is an unusual case where the meter does not pay for itself in a month or less.

For further information and prices

ASK FOR BULLETIN 5-A.

NEW JERSEY METER COMPANY

PLAINFIELD, NEW JERSEY

As a matter of reciprocal business courtesy, help trace results

Compressed Air Magazine

NEW YORK · LONDON · PARIS

Principal Offices: BOWLING GREEN BUILDING, Nº 11, BROADWAY, NEW YORK.

VOL. XXVI, NO. IV

APRIL, 1921

Rebuilding Devastated France and Its Industries

Compressed Air and Pneumatic Equipment Playing their Part in the Restoration of the Coal Mining Areas and the Old Industrial District of the North; A Gigantic Task in Reparation, with Encouraging Progress Made

By FRANCIS JUDSON TIETSORT*

COMPRESSED AIR equipment is one of the highly important mechanical factors in restoring France to a self-supporting industrial position. Reports from all centres of French industry have been showing an increased use of air compressors, of pneumatic tools, and in fact, of all air aids to economy and efficiency in production. In the reparations being made to the coal mines of the north the electrically-driven air compressor is playing a leading role. The French are using compressed air as never before in the metallurgical industries, in shipbuilding, in chemical factories, in road building, in oil works, in rubber factories, in glass making, in all the kiln industries, such as porcelain, and most unusual of all, in quarrying. On the latter head it is noteworthy that less than ten years ago the idea or suggestion of using pneumatic tools made the French quarryman smile. Pneumatic equipment is now the first consideration of the quarryman, since labor is scarce and poor.

Air is literally breathing life into the trade-making sources of the republic. It is taking the place of gallant men who made the supreme sacrifice by the hundreds of thousands during the war. The whole world has watched with concern the course of France in restoring her devastated regions, and in bringing her industries generally back to a profitable production basis. Much has already been accomplished, a surprising percentage in fact, but years of work still remain ahead.

To the student of industry, of business, of trade communication and of international interchange of goods, France is one of the most absorbingly interesting industrial countries in the world. The effect of the artistic and aesthetic qualities of the Gallic mind upon the entire world of business is appreciated too little by American and British men of affairs; at any rate this artistic impress upon trade is seldom analyzed except by bankers and professional economists. The Great War, as contemporary European historians seem to have decided to term the terrific and devastating struggle the world has just witnessed, had its effect upon all human agencies with which manufacturing and selling are concerned. The French suffered from it materially and in spiritual hurts as perhaps no other people, and it is important that this always be kept in mind in weighing their work of restoring their country to something approaching normal. Actual "normalcy," it is well to understand, is still remote.

The French, as a people, are entitled fully to the deep respect and sympathy of all nations in their postwar plight, for they have carried the torch of real culture and of good taste so far beyond their own frontiers and coasts that their civilization is felt wherever there is the instinct for the best in life. The capable theoretical economist and the intensely practical man of affairs alike concede that all business, or industry as it is termed in the broad sense, serves the one ultimate purpose of providing the home unit in life, and all that this implies. Existence on the best possible scale is the desire of the intelligent human; definitions of "best" in this connection may vary, but the desire exists to get the most out of life.

The French, as a nation, probably procure more in the way of a well-rounded existence than do the people of most countries. Any observer, who knows France, will subscribe to the truth of this statement. One therefore can comprehend in a measure what the effects of the war were upon France both in the material and in the spiritual sense, if he traverses the devastated areas. France is to this day still suffering from "shell shock," as one way of putting it, but there are skilled and healing agencies at work and the recovery of poise has begun.

France is a miniature United States. Few lands of her size have her remarkable natural resources, her varieties of climate, her great natural beauty. All that a self-sustaining nation requires is within her borders practically, excepting certain raw materials which are readily obtainable by bartering with her own surplus goods or materials. Such a country has been the inspiration of the French, and the fire of patriotism that burns within every loyal citizen of that republic is absolutely spontaneous. Millions of the flower of modern France went forth without a murmur to die or to be maimed during the recent struggle which centered its convulsing effects upon her blood-drenched soil. Britain, her next-door neighbor, owes less in one sense to France than does the United States, but the Anglican ideal has often benefited, nevertheless by the example of so forceful and so happy a temperament. The Frenchman really lives, but those of the Anglo-Saxon strain, in a comparative sense, probably merely exist. Cities like London, New York and Chicago have a great deal to learn from Paris, where even a metropolitan populace are able to extract more comfort, refinement, leisure and polite culture from their daily affairs than the general run of folk of any other large city in the world, with the possible exception of that magnificent capital and metropolis of the Brazilians, Rio de Janeiro. And Rio is largely modelled upon Paris and its manners and mode of living.

The foregoing viewpoints all have a great deal to do with the material restoration of northern France and the general rehabilita-

*NOTE—For assistance in obtaining materials, photographs, and statistics in connection with this article, the writer desires to acknowledge his indebtedness, and also offers his thanks, to Monsieur E. OGIER, Ministre des Regions Liberees, Monsieur F. A. CHOFFEL, Foreign Trade Adviser of the French Government, Mr. Ben K. RALEIGH, and to *Le Monde Illustre* and the editors of *Le Genie Civil*, of Paris.

tion of the entire country, as it is now proceeding. The writer had the great privilege of observing the finer elements of French civilization at work in the course of a recent sojourn of several months in which the entire republic was covered, from north to south, and from east to west.

The first impression one receives in visiting the devastated regions of either France or Belgium, from the human side, is a pronounced feeling of the futility of warfare as a means of deciding anything. One views appalling ruins, quantitatively in millions of tons, yet in their midst optimistic mankind is rearing new structures, tearing away the debris, and rebuilding gallantly for the future. One feels instinctively how colossal a crime was such a war as that waged in stricken France, and can begin to realize only dimly the great welt, the horrific scar across her northern territory. It is a vast and a deep wound. The French, while making herculean efforts to restore their coal mines, and the industries dependent upon these mines, and rear upon the dead ashes of a glowing past new homes, churches, schools and evidences generally of their high civilization, apprehend with keen sensitiveness that in their victory they suffered fearful losses.

But the French nation is rising like the phoenix above the dead ashes of the *Nord;* there are courage and hope in the air. The traveller and investigator in the region can feel it, and can now see the visible effects of it. The French are not a people that can be crushed; their citizenship and their patriotism are too virile. A British officer who covered part of the devastated country with me remarked on the spontaneity of French patriotism, whereas in his view the patriotism of their late enemies was an "educated patriotism." His view would be quickly challenged over the Rhine, probably, but the truth of the French part of the statement is at least always self-evident.

The enormous task faced by the Liberated Regions Ministry in restoring the devastated areas may best be understood by these figures:

Nearly 297,000 houses to be restored; 6,445 schools, 2,674 churches, 2,447 town-halls, and 49 hospitals had been partly, or totally destroyed.

Also, 4,486 industrial plants had been destroyed, 6,376 had been plundered, and 9,741 had been partly destroyed.

Most of the power plants and the richest of the French mines had been sacked.

Ruin, such as never before in the world's history had been wrought, was the portion of this northern part of the country. A problem of unparalleled proportions faced a nation which had lost 1,400,000 of its best men outright on the battlefields, and 3,800,000 of whose sons had been wounded, half of the latter grievously.

Workmen, and materials in vast quantiy were required, but where were they to be found in a country exhausted by such a struggle? Then there was the question of transportation. How was it to be managed with over-driven rolling stock, and in the face of the fact that the highways, railways and canals had been laid waste?

The answer has been in the fact that the spirit of France is indomitable. The understanding had been since December 26, 1914, that the nation would sustain the damages wrought by the war, and this understanding was made definite and crystallized into legislation by the act of April 17, 1919, which settled the matter of the participation of the state in the reconstruction of the devastated departments. The machinery of the French Government and private initiative were both set at work.

As an indication of how the work has progressed since the date of the Armistice, November 11, 1918, the population figures are impressive. On the first day of November, 1918, according to M. Ogier, there were 1,944,000 inhabitants in what remained at all habitable in the devastated region, but at the time of the writer's visit there last Autumn, there was a population of 3,600,000. It was announced on July 1 of last year that 161 towns had been officially "adopted" by other cities of the country and that life had recommenced in 2,998 villages. Of some 6,429 schools closed during the war, about 6,000 had been reopened, either in repaired buildings, or in temporary wooden structures.

By the first of May, 1920, 1,675 reconstruction offices had been opened and organized, and 141,041 workmen, including foreign labor which had been imported, were at work on the task of clearing out the ruins. Of 571,000 houses and buildings which had been destroyed or partly damaged, 198,475 had been actually repaired last Autumn, despite troubles with workmanship and materials.

Most houses were rebuilt of wood, of course, and by June 1 of last year, 66,331 of these houses were sheltering 300,222 persons. Then there were also 636,825 inhabitants lodging in repaired houses, so that nearly a million people had come back to the land taken away from them by the invaders.

Of 33,000 miles of roads that required repairs at the time of the Armistice, 13,620 miles have been greatly improved, and 2,200 miles have been completely repaired. Equally earnest efforts have been made with respect to the roadbeds of the railways, and all of the main trunk lines of France have been put to rights. Of 1,600 miles of local, or branch lines that required attention, 923 miles have been provisionally restored, and 297 miles of trackage is used for normal traffic.

Contrary to past practice, composition road surfaces are being put down by the French highway authorities in the Rhône Valley. At Givors a test is being made of two miles of an Italian composition. This has a cement basis and is guaranteed for fifteen years. The road authorities have expressed their willingness to experiment with competitive types of road material. Much new machinery has been installed in the quarries in this district. At Brignais an immense stone crusher is at work, manual labor being thus replaced, while at two others electric pneumatic crushers are in use and are more than tripling production, the daily production of road material being in each case 350 tons. Similar although less powerful pneumatic crushers are also working at neighboring quarries. The authorities have had the greatest difficulty in finding the necessary labor, man-power being pathetically short throughout France. Compressed air machinery came to their rescue and the French officials are now actively encouraging the use of such pneumatic machinery on their roads and in their quarries.

Before looking at the mining and industrial side of the situation, it is well to note, in passing, the vitally important agricultural effort which has been put forth. In 1920 nearly 2,200,000 acres were sown to crops, and for this purpose the *Office de Reconstitution Agricole* supplied 125,600 tons of seeds and 127,800 tons of fertilizer. The ten invaded departments can now supply their own needs in cereals, and this year they will no doubt be able to ship part of their production to other sections of the republic. In order to increase cattle, which naturally was heavily decimated by military requisitions during the war, the Government has given back to farmers 114,022 head of cows and oxen and 208,210 horses, besides making cash payments of 1,340,228,435 francs for agricultural machinery and materials.

To better its financial situation, to hasten the return of industry to normal, to produce goods, and to give work to discharged soldiers, it became extremely urgent that the industrial plants of the north should be restored. It was decided not to delay industrial rehabilitation pending an inventory of damages which the government had agreed to pay; any thought of waiting for Germany to pay its indemnities was also abandoned. An organization instituted in 1916 and known as the *Comptoir Central d'Achats pour les Régions envahies* and the *Office de Reconstitution Industrielle des Departements victimes de l'invasion* promptly and efficaciously went to work, determined to override all difficulties. It would be too long and too involved a story to explain the workings of the latter wonderful organization, but one thing may be said for it—it has taught the whole world a lesson in directness and efficiency.

The damaged departments were divided into ten different *secteurs* and supervising commissioners were assigned to them, picked men whose sole endeavor was to get action, quick action, and plenty of it. They worked fast. Without even asking the manufacturers for an exact estimate of the damages they had suffered, the commissioners opened accounts with the manufacturers and advanced funds to them. What happened? The results, briefly, were these:

By August of last year, 20,052 manufacturers, who had suffered damages equal to 7,382,778,093 francs, 1914 value, had obtained funds from the government. With the aid of the Central Purchasing Commission, machinery was purchased in France as far as it was possible, and the remainder in foreign countries. Of 3,903 damaged plants, which had been in operation before the war, employing 729,185 workmen, 706 plants were in working order and functioning again by July, 1919, and a year later, or about the time of the writer's visit, 3,004 plants were functioning,

The Ruins of the French Coal Mines of the Nord

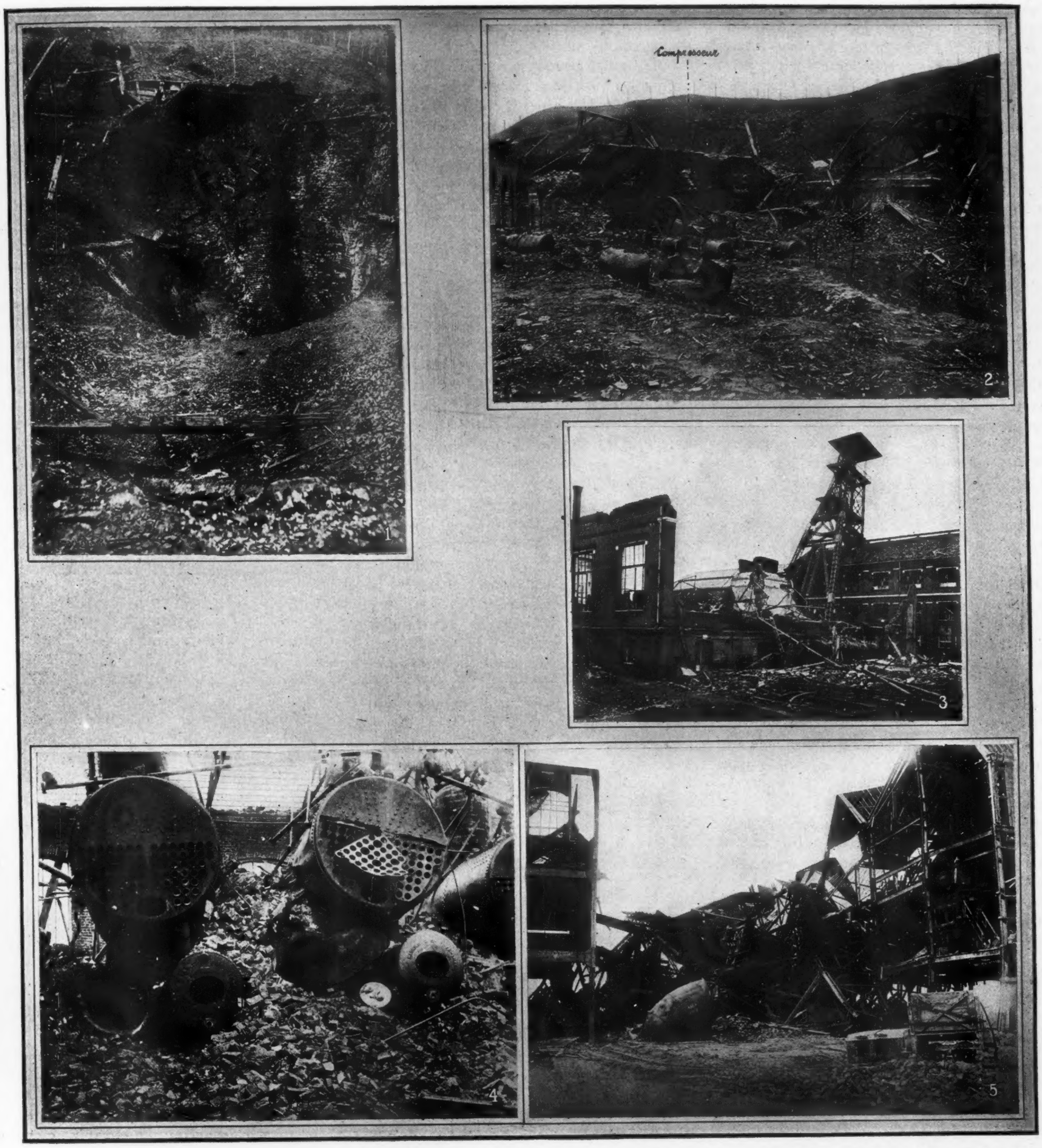


Fig. 1. What happened to the mouth of a Carvin mine shaft. Fig. 2. Remains of an air compressor in the Carvin ruins. Fig. 3. Wrecked shaft house hoist, etc., at Anzin. Fig. 4. Systematic destruction in a Carvin power house. Fig. 5. Devestation like that wrought by a cyclone.

that is to say, nearly 77% of them, and they were employing 307,057 men in production. Another 91,369 workmen were still employed in restoring factories. About 42% of pre-war personnel was back at work, a truly remarkable result achieved by coöperation between private initiative and government finance.

Just before his inauguration, I saw President Millerand on one of his periodical visits to the devastated areas, and he declared to the members of his party: "These are victorious results. I leave the region with a great sadness, but at least with the certainty of the complete recovery of our dear France. Patience is necessary to finish this task, and patience is a rare virtue. We cannot rebuild in a day what required many years to create."

With respect to the financial side of reparation or restoration work in France, the Paris Government has been extremely hopeful that it would be able to borrow large amounts in America as advances against expected reparation payments from Germany. The

national treasury of France has a present deficit of about 50 billion francs, or approximately $3,500,000,000. This represents largely the money already paid out, or advanced to French mining and manufacturing interests for reconstruction. If loans are unobtainable in America against the German reparation payments, the French government will face a serious situation. Even five years of expected payments from Germany would scarcely meet the deficit. There is therefore only thinly disguised anxiety at Paris over the attitude of President Harding's administration toward France's internal financial problem.

To return to the devastated districts, the situation in towns that have been partly rebuilt and restored is not too happy. Much disease is to be found among French children in these towns, and the rising generation is in part still suffering from undernourishment. In addition, thousands are living and sleeping in crowded cellars. Much good work has been done, of course, and America has been generous, but the amelioration of conditions is still a long way from completion.

Two years after the Armistice the writer found that the resumption of mining in the Lens and Lieven colliery district was proceeding on only a pitifully small scale. It was indicative of how thorough was the work of the destruction of the economic resources of the country. The colliery plants in the fighting zones were gone; the enemy had blown up engines, machinery, compressors, hoists, buildings, pumps, everything, piece by piece. The chief engineer of one of the big French coal concerns, in summing up the situation, said:

"Before the war yearly production of these particular mines was 4,000,000 tons. We had 30 shafts and 17,000 workmen. We now have 1,500 back at work to pump out the mine and clean up the properties. The Germans flooded the Lens mines and our first concern is to get the water out and pumped into the canals. This water pumping ought to be completed early in 1921. When the galleries are dry the cleaning and repairing will be begun, but it will be a slow process, and we will need thousands of workmen for it. By 1922 we hope to have our mines producing and to be able to employ about 8,000 miners. It will take five or six years, however, to make our properties produce three quarters of their pre-war output."

M. Bailly, a well-known French mining engineer, finds that France has enough coal to supply all her needs if her resources were to be fully exploited. M. Bailly takes into consideration the conditions which will prevail in 1935, when the deliveries of German coal will have ceased and when, perhaps, the deliveries from the Sarre will also no longer be forthcoming.

Basing his figures on the programme of mining mapped out just before the war, M. Bailly estimates that French production should reach 60,000,000 tons by 1935. The needs of the country, however, in 1913, were 64,000,000 tons, and fifteen years hence they will probably reach, he estimates, 100,000,000 tons, so that France will have to make a very considerable effort, aided by the most modern mining machinery it is possible to obtain, if she is to be independent of Germany, Great Britain, Belgium and the United States.

Normally France imports about one-third of the coal she consumes, so that it is by no means a small quantity that will have to be added to her normal production if she is to become self-supporting. The total available coal resources in France are estimated at 22 billion tons; seventeen billion tons in old France and five billions in Lorraine; these coal-fields are considered available by the present known methods of exploitation. On the basis of pre-war exploitation, this represents coal enough for five centuries, and if the extraction amounted to 100 million tons a year the existing exploitable resources would be sufficient for more than 200 years.

M. Bailly does not consider it necessary, however, to make provision for so far ahead, for he believes that engineering methods will be devised eventually for mining at a depth of 2,000 metres, and that this will disclose and develop much greater riches in coal deposits. By repairing damaged mines and increasing the pre-war production of these and of non-damaged mines and also by sinking new shafts, M. Bailly believes that a production of 100,000,000 tons a year by 1935 could be attained. The creation of new shafts in the minefields already partly exploited should, furnish, he thinks, 30,000,000 tons. These new shafts would not be sunk in the basins of the Centre or the Midi, which do not offer advantages for new work, but in the North where the possibilities are unrestricted.

Regarding the unexploited resources, the Forbach district, which extends between Forbach and Pont-à-Mousson, covering 75,000 hectares, offers five billion tons and there is said to be room for more than 50 shafts capable of producing 10,000,000 tons.

In the restoration of the mining properties that were devastated by the Germans a large quantity of new machinery has been employed, furnished principally by England, the United States and Switzerland. A considerable number of air compressors of Ingersoll-Rand make of various types have been used. These compressors are used in connection with mining equipment, together with many pumps of English and Swiss make, all using electric power. There have been some excellent sales of small pumps and also of pneumatic coal picks and pneumatic hammer drills.

As regards power, it will be interesting for readers of COMPRESSED AIR MAGAZINE to note that there is a coöperative effort under way among the French mine owners to provide large central electric generating plants on the super-power zone principle such as is now attracting wide attention in America, and which was ably described in these pages in last month's issue by Mr. Robert G. Skerrett. There will doubtless be a general distribution of electric power on a three-phase, 3,000-volt, 50-cycle basis throughout the coal-mining district in the near future. This will work large economies in fuel. The whole idea is to standardize electric current in France, a much needed reform, as engineers explained to me, for different conditions formerly obtained at each mine or industrial plant, a most uneconomical state of affairs. It was also difficult to provide electrical materials. Even now there is little market for steam-driven air compressors; industrial executives all want electric drive.

The technical arrangements for the construction of the Grand Canal d'Alsace and its power stations are now considered to be complete. Unless unexpected and unanticipated changes are made the canal will start at Huningen and end at Neuhof, a suburb of Strassburg. Compressed air machinery will be extensively used in the work. The canal will be between 85 and 124 metres in width, according to season, the fall at the locks varying between eight and twelve metres. The locks themselves will be 125 x 25 metres in order to permit the passage of Rhineland barges. Although the use of compressed air machinery will cut the cost considerably under the original estimates, still, owing to the high cost of construction, it is unlikely that the whole canal scheme can be completed for many years. Attention is, first, to be devoted to the portion lying between Huningen and Brisach. The latest estimate for the erection

© Keystone View Co.

A gasoline tractor plough near Salis, France, indicating adoption of American agricultural methods.

Illustrations Which Indicate What Scientific Destruction Means

Figs 1 and 2. These are exterior views indicating the utter desolation wrought in a once happy and prosperous industrial region. "Scientific" destruction without "military" necessity. Fig. 3. All that is left of an electric hoist in a mine. Not promising material to start business anew with. Fig. 4. Shaft house and buildings in the Nord after the invaders left. Fig. 5. Wreck of an electrically propelled air compressor. Fig. 6. "Closeup" view of a smashed shaft house equipment.

of stations and locks on this portion of the canal amounts to 600,000,000 francs. If the canal is to pay its own way it is calculated that the price of electricity in the neighborhood will be about four centimes per kilowatt hour.

It was in the principal industrial district, and at the same time the wealthiest part of France that German troops appeared for the first time at the end of August of 1914. By August 25 the Anzin district was completely occupied and isolated from the rest of France. The battle of Douai on the 1st of October gave definitely all the Valenciennes district to the Germans. Nevertheless they had to stop on October 24 at the border of the Lens-Liévin and Béthune districts. On this date besides the North mines, the Germans were occupying the following coal mines: Ostricourt, Dourges, Drocourt, Carvin, Meurchin, Courrières, Lens, Vimy, one part of the Liévin district and the Nos. 3, 4 and 8 plants of the Béthune mines.

Gallant French troops forced back the Germans near Vermelles and caused them to aban-

don Le Rutoire and the Plant No. 4 at Béthune. The front line was then fixed at Carency, Ablain, Calonne, the west part of Loos and Violaines.

During the first year of the war the destruction wrought by the Germans was of minor importance. Haunted by the fear of seeing allied troops spring up from the mines, which the invaders thought were intercommunicating, they had hurled coal trucks down into the mine shafts and cut the hoist cables at Liévin, Lens and Meurchin. The recapture of Loos in September, 1915, marked the beginning of their really systematic destruction.

They blew up the mines at Lens, flooded them and afterward destroyed the machinery in surface buildings. They did the same thing simultaneously at Liévin. At Meurchin, early in 1916, they used such a quantity of explosive charge that the complete submergence of the plant underground occurred.

In April, 1917, British troops by an audacious attack succeeded in taking the Vimy hills and the Germans left the Nos. 1, 3 and 6 plants of Liévin in ruins. At the same time some of the Lens mines were occupied by French troops.

The Berlin General Staff next decided that the moment had arrived to evacuate Hénin-Liétard, and production ceased at Dourges and Courrières, where 160 boilers were destroyed. In the Lens, Liévin, Courrières and Meurchin districts the Germans not only destroyed the plants, but also the miners' houses. Liévin was deserted by the Germans after the recapture of Vimy; Lens was recaptured on the fourth of October, also Carvin, Courrières and Drocourt.

The plants situated at the east of the line Lille-Hénin-Liétard (Ostricourt, l'Escarpelle) had been worked during all the war up to that date. At l'Escarpelle mines the Germans started in blowing up the mines but the vigorous protests of M. Lemay, engineer of the Compagnie des Mines d'Aniche, made them hesitate and the Germans finally stopped the destruction for the time being.

Ruins of Mine No. 3 at Carvin on which restoration work is being done.

Everywhere else (at Ostricourt, at Aniche, at Flines, at Azincourt, at Douchy, at Vicoigne) the enemy had only time enough to destroy the plants above ground. The houses were nearly all saved in this region.

It had been hoped at one time (a little time before the Armistice) that the mines at Thivencelles and Crespin, would be saved after President Wilson's intervention and General Hindenburg's order, which proscribed all destruction which had not a military purpose. Nevertheless the devastation proceeded at Crespin and Thivencelles.

The most important damage done was underground. In the eastern part of France only part of the coal properties was destroyed. At the Thiers mine of the Compagnie d'Anzin, the property was flooded. The Gayant mine of the Compagnie d'Aniche, and Mines Nos. 7 and 7 (*bis*) of Courcelles, Mine No. 8 of Auby and Mine No. 6 of Leforest were burned.

The situation was worse in the west. At Courrières nearly all the mines were blown up and flooded. Only Mine No. 18 was spared. At Dourges Mines No. 3, 4 and 7 were flooded. At Drocourt Mines Nos. 1, 2 and 3 were blown up. The same thing occurred at all the mines of Lens, Liévin, Meurchin, Carvin and at Mine No. 8 of Béthune. At Meurchin the Germans drained into Mine No. 4 the waters of Wingles' marsh, and into the Mines Nos. 9 and 17 at Courrières the water from the Harnes' marsh; into Mine No. 7 the water from the Fouanières-les-Lens, into Mine No. 3 of l'Escarpelle the water from the Deule river, and they attempted the same thing at Thivencelles with the Escaut river. This flooding caused enormous damage.

Above ground the ruin wrought was certainly done by experts. Proof of this lay in the discovery made at Courrières of a map of the mines where directions written in red ink indicated the exact places for the explosive charges. Attached to this map was a list of all the machines which were to be blown up, and giving the various quantities of explosive-charge to be used.

At Crespin everything above ground was wrecked. A half mile of railway track was taken away bodily. At Thivencelles the Saint-Pierre mine was looted. The damages at Anzin were more serious. The 20 mines of the Company had 33 *chevalements* and only four escaped destruction. The railway tracks, which were 80 miles long, were found by the French in very bad condition. Twelve bridges were blown up. The hoisting machinery and air machines were mostly destroyed. Of 40 fans only nine were left,

Hopeless jumble of steel frame work at Carvin Mine No. 4, showing the effects of German explosives.

and of 22 air compressors there were only two left intact.

At Douchy the mines were in the same condition; also the *chevalet* at the Schneider mine had been partly broken up. The machinery at l'Eclaireur and Beauvois, had been devastated; only one boiler was left. At Naville only a few boilers could be repaired. Of 228 coke furnaces 80 were wholly destroyed. One 200 H.P. air compressor was found in a good condition.

At Aniche the destruction was nearly complete. The machinery and the buildings had been blown to bits with dynamite. The miners' houses were badly damaged. The Somain and Gayant plants were dynamited. Of 27 *cheminées* only one was found standing unhurt. Very little material could be used again: one fan was salvaged at the Lemay mine, also one small compressor and two hoists. At l'Escarpelle, all the buildings had been sacrificed; 34 boilers out of 77 could be repaired and two hoists were safe.

The Ostricourt mines had been injured by bombardment before 1918, chiefly at Mine No. 2 of Libercourt, and they were badly ravaged by the Germans. The farther towards the west the investigator proceeded the more vicious was the devastation. The villages near Valenciennes and Douai were not injured so much. They show chiefly the effects of battles when the Germans were retreating. On the other hand beyond Dourges the country is quite bare.

When retreating the German troops looted the above ground plants at Dourges. The soldiers smashed the axles of railway cars which they could not take away, and the rails were twisted by explosives. At Drocourt nothing was preserved.

At Carvin, of Mine No. 1 there was only a yawning excavation left; Mine No. 4, one of the best equipped in Pas-de-Calais, was battered into dust and debris. At Courrières, Lens, Liévin and Meurchin practically nothing of value was left.

The foregoing facts, obtained from the mine engineers and government authorities, cover only part of the history of actual devastation and the facts concerning restoration work to be done. Such great quantities of water have been taken out of some of the mines by the powerful pumps that it has been necessary to raise the banks of the canals into which the water flowed. The restoration of electric power plants under the zoning principle, which has been going on, has helped to simplify the pumping job.

While the complete restoration of the north mines will take possibly five years, as already indicated, production of coal is meantime increasing every day, which is a hopeful sign. One of the greatest tasks ahead is the cementing of the shafts of many of the mines. The average cost per mine is 500,000 francs and the time required is about six months per mine. In this work the pneumatically operated cement gun should prove of great assistance. Another large undertaking at the mines has been the rebuilding of miners' houses, and to this task the operators have given their careful attention from the practical sociological point of view.

Exclusive of Alsace-Lorraine, the "lost provinces" now regained, France has a total area of about 207,000 square miles, including the island of Corsica. The latter is almost precisely the size of the American insular possession of Puerto Rico, and approximates the size of Long Island, in New York, being 3,367 square miles in area. France has mountains and valleys, rivers and brooks, minerals, agriculture and manufactures, and normally it is a beehive of activity in almost every branch of human endeavor, and its people are so thrifty that Poor Richard might have been the mentor and guide of every French child from infancy. France has therefore always been prepared financially for almost any emergency, and its devoted people have repeatedly gone deeply into their "cotton and lisle national banks" and into mattresses and wall crevices for the wherewith to pay the cost of the recent struggle. Their thrift and their honesty in meeting both private and national obligations have been their great bulwark of defense. While the French standard of recompense for services is not so high as in some other countries, the people make such excellent use of what they do win in profits and wages, that stormy times do not find them helpless; they present an object lesson for other peoples, especially for their less provident friends, the Americans. The wastefulness of general industry and of living methods in the United States would be abhorrent to the French mind. When the Frenchman does anything he performs his task with minute care, precision and as a result of the most particular planning, and this is seen in their industries. The lowliest workman and the topmost executive use discretion and economy that obtain the best results with the lowest outlay in power and materials, and after all this is the greatest *desideratum* in all the complex business of producing and living. They have not the American genius for production and organization on the enormous scale of many great business enterprises in the United States, but as a longtime American resident in France said to me, "they get there just the same with their own peculiarly French methods."

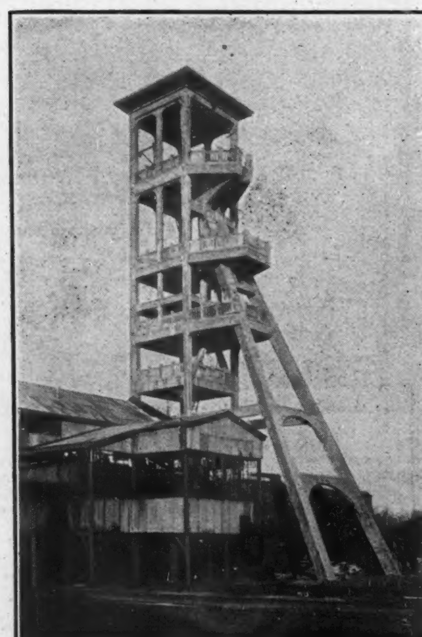
If France could combine her wonderful precision with America's enormous efficiency in organization, she would be, always considering her size, the greatest industrial nation on earth; of this, the world's leading production engineers have long felt sure. The one bar to this result is that the Frenchman dislikes change, the upsetting of the accepted order of things, so that any such result would have to depend upon future generations. However, who that loves France and her people would care either to Americanize or Germanize her. It is almost unthinkable.

The French nation has encountered a terrible bar to rehabilitation in loss of man power. In the manufacturing industries alone the country had something more than 4,000,000 male workers before the war, and in military service France lost just about that number, as has been previously noted, in killed and gravely wounded and mutilated men. It is the very young and the as yet not skilled workers upon whom she must rely now, with only a sprinkling of skilled workers and the old fellows of industry, but they are all nobly doing their part and straining every nerve.

With the exception of the Loire, the Bouches-du-Rhône and the Rhône, the chief industrial departments of France are to be found in the north and northeast of the country. Before the war there were eight other departments besides those named, in which industrial workers exceeded agricultural workers by 50 per cent, and these were as follows: The Nord, Territorie de Belfort, Meurthe-et-Moselle, Ardennes, Vosges, Pas-de-Calais, Seine-Inférieure, and the Seine.

The Seine department, which includes Paris and its suburbs, and which has the largest manufacturing population, is of course largely occupied with the manufacture of dresses, millinery and articles of luxury such as perfumery and cosmetics, but it plays a leading part in almost every great branch of industry with the exception of spinning and weaving, and it is a great compressed air consuming district. The typically industrial region of France before the war was that of the Nord department, a seat of the woollen industry, and also prominently concerned in other textile industries, in metal working, and in a variety of other manufactures, fuel for which was supplied by its nearby coal fields. Other industries, not taking into account wine, or agriculture in general, with which we are not concerned, are tanning, brick-making, and garment-making, but these are rather evenly distributed throughout the republic and are particularly to be found in or near all larger population centres.

The principal mines of France, aside from coal, are its iron mines. The Flemish coal basin employed more than 100,000 hands be-



A specimen of fine modern construction in France at the St. Marck Mine, Anzin. Note the new "chevalement" of solid concrete and the all-steel building.

Better Times—The Visible Signs of a Return to Normal

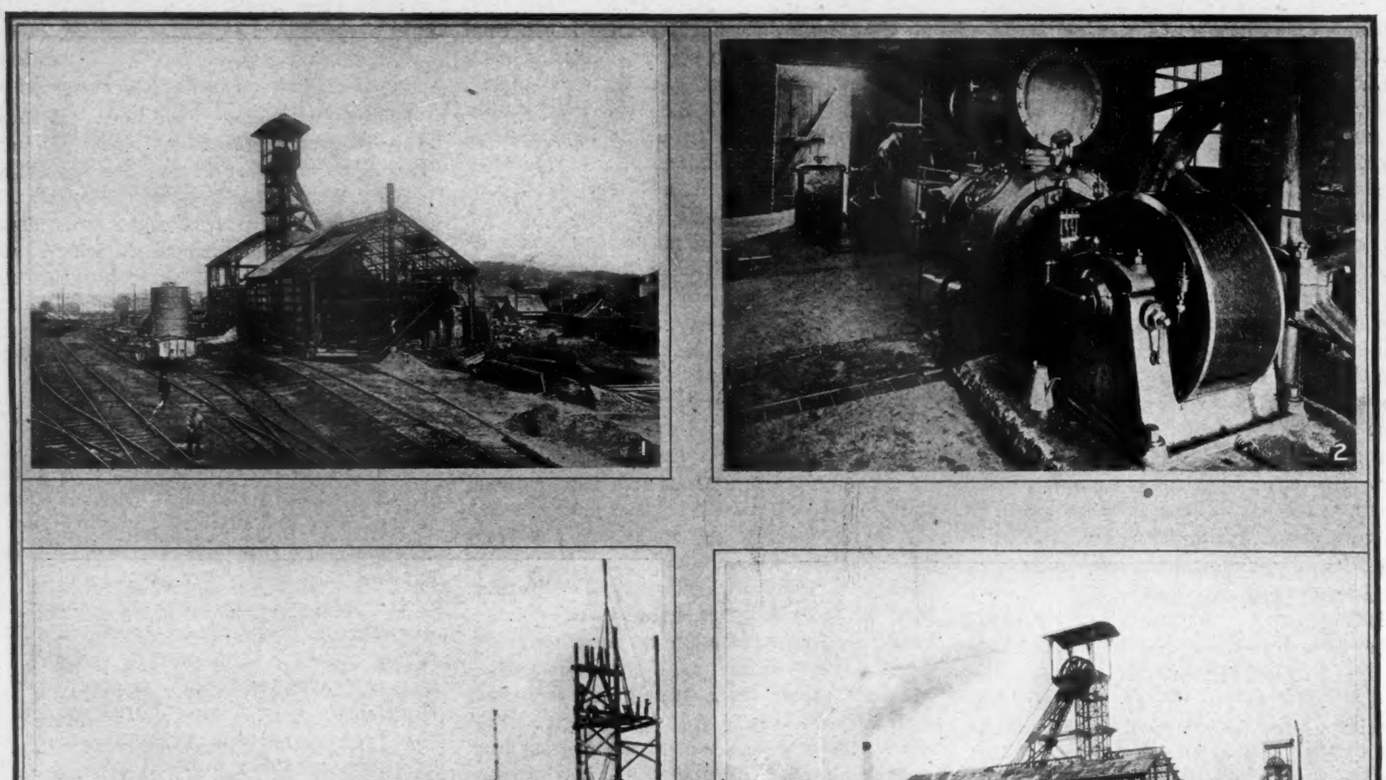


Fig. 1. Progress of restoration at Mine No. 3 of the Cie des Mines de l'Escarpelle at Point-de-la Deule (Nord). Fig. 2. Electrically driven air compressor at a French coal mine which has been able to resume operations. Fig. 3. A view taken last summer for this magazine showing rehabilitation at a Carvin mine. At the left is the pump house. For the time being frame construction has superseded masonry. Fig. 4. "Coming back" at the Escarpelle Mine No. 7 at Courcelles-les-Lens, in Pas-de-Calais. Fig. 5. View of an electric pump (Boving) installed at Mine No. 10, at Lens, and photographed for this article last autumn. This big machine is used in unwatering. Fig. 6. Present-day view of surface structures of Escarpelle Mine No. 7.

fore the war and produced 60 per cent of the coal mined in the country, amounting to something less than 40,000,000 metric tons, of 2,204 lbs. to the ton. French lignite is found for the most part in the department of Bouches-du-Rhône, near Fuveau.

Generally speaking, the iron mines of the country are more numerous than its coal mines, but they have never yielded a sufficient quantity of ore for the needs of the French metallurgical industries. Referring to old pre-war statistical tables, it may be noted that the production of iron gradually increased throughout the nineteenth century and into the first decade of the twentieth, but on the other hand a decline in price operated against a correspondingly marked increase in annual values. The basins of Longwy-Briey

of Muerthe-et-Moselle furnished 84 per cent of the total output during ten years before the war, and they may be fairly considered as one of the principal iron-producing regions of the world, though of course their output is small compared to those from the Minnesota and Michigan deposits.

Next in importance to iron, comes zinc and lead; the former coming principally from Malines, Les Bomettes and Planioles, and the latter ore from Chaliac. Iron-pyrites come almost entirely from Sain-Bel in the Rhône area; manganese from Ariége and Saône-et-Loire, and antimony from the departments of Mayenne, Haute-Loire and Cantal. Copper and mispickel are mined only in very small quantities in France.

France produces much excellent rock salt and the sea-salt industry is also important. Sulphur is found near Apt (Vaucluse). There are asphalt deposits at Seyssel and Puy-de-Dome. Quarries of various descriptions are numerous; slate and stone quarries predominating. In these, since the war, there has been a large increase in the use of pneumatic equipment, I was informed, because of its labor-saving capabilities and economy. Plaster is produced near Paris. There is kaolin of fine quality at Yrieix, and there is hydraulic lime at Ardèche. Lime phosphates are had in the Somme department. There is marble in Haute-Garonne, the Hautes-Pyrénées, Isère and Pas-de-Calais, and cement also in both of the latter two districts. Paving stone is supplied in large quantities by Seine-et-Oise, and brick-clay is worked chiefly in Nord, Seine and Pas-de-Calais. The quarry products of France average in value nearly $50,000,000 a year, two-thirds of this amount covering building materials.

American mining and metallurgical men who have not studied the situation may be surprised to learn that so small a country as France produced before the war annually more than 3,000,000 metric tons of cast iron and more than 2,000,000 metric tons of wrought iron and steel, their combined value at the old market prices being above $125,000,000 in American exchange. In five French departments there were 45,000 men engaged in producing pig iron and steel and in the production of engineering material and manufactured goods the metallurgical industries employed about 210,000 workmen at the height of the best production period before 1914. These figures were given to me by an authority who pronounced them conservative, and on checking them up in published statistics they were found to be, if anything, under-statements.

In viewing these facts for foreign production executives interested in French industrial capacity, the thought has been to show what a gigantic task restoration of many of these industries has been, with particular reference to the north and east of France, where as we have seen, occurred the worst and most thorough and systematic devastation by the invading German military. The visible proof to readers who have not seen with their own eyes the sort of ruin that was wrought will be found in the illustrations accompanying this article, which were among scores loaned to Compressed Air Magazine by the governmental authorities.

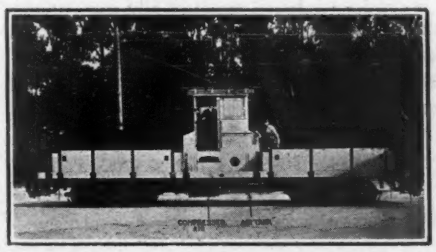
If the world believes France is willing or eager to show its economic wounds, it is much mistaken. I found that there was a sensitiveness in France not unlike that felt by the individual cripple among his whole-limbed fellows. Some of the pictures displayed with this article were taken by French government photographers and until recently their reproduction was strictly forbidden.

COMPRESSOR ON SPECIALLY EQUIPPED WORK CAR

THE FOLLOWING is a description of the air compressor equipment on the specially designed work car of the maintenance department of the Municipal Railway of San Francisco. It consists in one motor driven air compressor for 600 volts direct current; a self-cleaning air strainer; one compressor governor, set to cut in at 60 lbs., and cut out at 75 lbs, and two 16x42-in. main reservoirs.

The air compressor circuit is taken from the trolley wire and passes through switch and fuse, to the governor, from where it goes to the compressor motor, thence to the ground; the switch used being a General Electric cut out and snap switch.

All control and motor wires are run in conduit fitted with porcelain covers provid-



Compressor on specially equipped work car.

ing holes for the exact number of wires to be brought out of conduit. A hardwood chafing and spreader block protects the leads to the motor cases. Resistance boxes, in addition to being installed by the insulation furnished by the equipment manufacturer, are bolted to oak resistance stringers 2x2-in. which in turn are bolted to the floor framing. These stringers and also the car floors over the resistances and for six inches on each side of the resistance are covered with J. M. Transite board ¼-inch thick, attached with screws. Joints in the board are closely fitted and all of its surface painted with heavy coat of paint.

The underside of the floor over the air compressor reservoir and switch group has a similar covering of ¼-in. transite.

Trap doors are constructed in the cab floor to permit of inspection and maintenance of the air compressor.

Brake levers and rods are so arranged that a harmonious operation of the hand brake and air brake is provided. The size of all parts is suitable for operation with 85 lbs. of air pressure in a 14-in. cylinder. No lever is less than one inch in thickness and pull rods connecting the cylinder levers, and truck levers are not less than 1¼-inch in diameter. All pull rods are so installed that with a loaded car, they will clear the motor cases by not less than two inches on vertical curves.

Two valves for the sanding device are mounted adjacent to the motorman's brake valve in such a position that either may be operated at the same time the brake handle is used.

There is also a ¼-inch pipe connecting the sander trap pipes with a "T" branch to the emergency valve. On either side of the branch there is a ball check valve for preventing the air from backing up when the traps are operated separately.

The trolley circuit for air compressor, control and for lamp, are taken from the trolley lead by means of a terminal fastened to the terminal post on the positive side of the main switch in the cab.

INTERNATIONAL FLOATING EXHIBITION

What might be described as a floating exhibition is being organized at The Hague. It is intended not only for Dutch traders, but for all European merchants and business men who care to take part in the venture. Last September a "Syndicate for Industrial Fairs by Steamers" was founded, and the steamer Macedonia, of 6100 tons, was chartered as an exhibition ship. Her four decks have been arranged in such a way as to allow for the display of all kinds of goods, the total space available for exhibits being 5000 cubic metres. A complete commercial organization will sail on the Macedonia, including departments for accounts, sales, correspondence, credit, banking, a commercial inquiry bureau, &c. All these facilities are at the disposal of subscribers, who will be charged a fee for exhibition space, while a commission of ten per cent. will be claimed by the Syndicate on all business done during the voyage. Two directors of the Syndicate will sail on the Macedonia in order to control the enterprise, and two competent business men will precede the exhibition ship to herald her arrival and to make all necessary arrangements in every port of call. It is proposed first of all to follow the Eastern coasts of North and South America.

Quality is the rule by which profits are measured. It costs no more to manufacture a good product by using care and judgment than it does to manufacture a poor one. It requires the same amount of labor and about the same amount of money for materials. When one takes into consideration the loss on goods returned because of lack of quality it costs more to make an inferior grade than a high one.

A proposal is being considered to preserve the French supply of gun-cotton and nitrocellulose explosives—about 90,000 tons—by placing it in tanks at the bottom of a lake in the Pyrenees. Stored in this way at a safe and constant temperature, it is believed that the material would neither deteriorate nor decompose.

Bottles and Tumblers by the Billion

Glass Production Has Undergone Great Expansion in Recent Years With Further Development Expected in the Future—Compressed Air Has Made Possible the Automatic Labor Saving Glass Blowing Machine

By ROBERT G. SKERRETT

LESS THAN a century ago the start of the making of steel in America inaugurated an era of amazing industrial potentialities.

To-day, the United States is in the adolescent period of another domestic industry that bids fair to develop fields of usefulness quite as wide and equally essential to the country's convenience, well-being, and national self-sufficiency. The manufacture of glass in America, great as its present proportions are, is certain to expand tremendously and may reach a status akin to that now enjoyed by steel in the realm of metallurgy. In truth, some of the agencies that have been instrumental in revolutionizing both the output and the character of modern steels will inevitably effect correspondingly profound changes in glass products of all kinds.

Glass is a commonplace in everyday life, and yet precious few persons have even an elemental conception of its composition and the methods employed in its manufacture. There are the best of reasons why we should familiarize ourselves at least generally with this fascinating department of industrial endeavor, especially when reminded of the vast sums spent each twelvemonth in turning out glass commodities of divers sorts. In 1914 American glass production was valued at $123,000,000: since then the business has expanded greatly.

Though glass blowing flourished as an art in Egypt fully 3,500 years ago it is probably not an exaggeration to say that only within a span of a few decades has this ancient industry acquired anything of the dignity bred of scientific association. Rule-of-thumb methods, formulae of questionable value, and practices that smaked of the crude have been pretty common guides until within the memory of men now living. This seems strange in view of the fact that the making of glass in the United States was begun at Jamestown, Virginia, as far back as 1609. Thanks to the labors of American inventive genius in the last fifty years, to industrial research much more recently, and, finally, to the impetus given glass making by the great War, the industry has risen to a plane of technical eminence that is of the utmost economic significance.

In eons past, when the crust of the earth was undergoing titanic modifications, and the major mass was in a molten state, nature compounded in that seething crucible the gems that have since dazzled the eyes of humankind. The Egyptians, simulating in puny fashion those processes, became so skillful in the manufacture of glass, historians relate, that they were able to counterfeit precious stones with astonishing success. The making of glass partakes inevitably of the mysteries attending the evolution of the earthen shell upon which man has reared his empire. The future of the glass industry is undeniably dependent upon a fuller knowledge of what takes place in the melting furnace; of the part played by each ingredient and the interrelation of all of them; and, possibly upon the development and maintenance of higher temperatures which shall be subject to very nice regulation.

Today, it is authoritatively declared that many manufacturers of glass have but a vague and indefinite knowledge of the chemistry of the materials which they employ—and this in the face of the fact that glass is a direct consequence of chemical reactions. True, they are aware, of course, that they must mix ingredients such as lime, soda, potash fluorspar, lead, sand, and various other materials, and then subject them to the fusing action of intense heat; but it has remained the belief among a goodly percentage of glass producers that most of these constituents are volatilized and dissipated by way of the smokestack—leaving behind only the molten sand to be worked into the forms of glass desired. Gradually the more progressive of the glass makers are learning to appreciate the labors of the experimenter in the laboratory, and it is dawning upon them that in many ways the manufacture of glass is, indeed, very much like the production of steels which are susceptible, because of suitable alloys, to a multiplicity of special services.

In lieu of a better grasp of the chemistry of their art, American makers of glass have, in the main, during the last three decades, sought to improve their wares through the medium of mechanical facilities, and, fortunately for the industry, the creative minds of many men have been devoted to the designing and the perfecting of remarkably efficient machinery. This has made it possisble for the producer to lower his costs materially. Even so, such apparatus cannot work up to advantage glass that is primarily bad; and they tend to emphasize the need of a better balanced effort or closer coöperation between the engineer and the chemist.

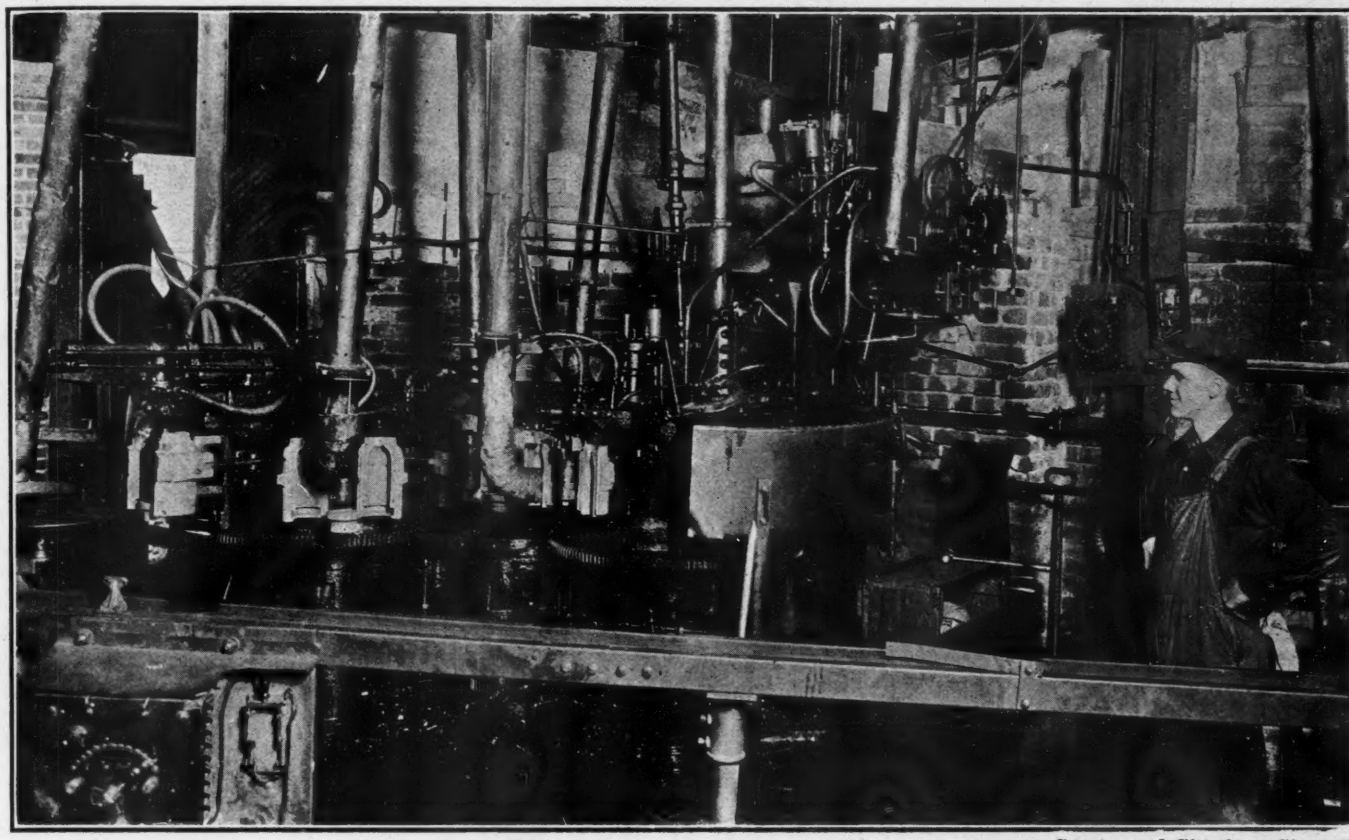
This brief summing up of the present status of the glass industry in general is not offered by way of discouragement but to make it easier to appreciate what is being accomplished and to visualize the superior commodities and the higher efficiencies that can be confidently looked for in the near future.

As might be expected, the immediate object in turning to mechanical aids is to increase the yield in a given period and to assure a more nearly uniform product. This, of course, involves doing away with the less speedy and more expensive hand worker and the minimizing of those losses that are often large and generally uncertain wherever the human equation has to be taken into account. The substitution of machinery still leaves plenty for the skilled craftsman to do, and more hands, of course, are needed sooner or later to deal with the amplified output of the factory. But the total cost for labor on any unit article is necessarily lowered—the ultimate consumer getting the benefit of cheapened manufacture.

The advent of semi-automatic and automatic machinery has otherwise affected for the better the glass industry. Where most of the work in the past was done by hand the factory structures were not infrequently flimsy frame affairs and of a character that intensified the trying physical conditions under which the operatives labored. Glass plants were then extremely simple in their get-up and could be speedily reared and abandoned after comparatively brief use without entailing a serious monetary sacrifice. The manufacturer shifted his base of operations from time to time to be near low-priced fuel; and this explains the migration of the industry from the Atlantic seaboard inland as our coalfields and then our sources of natural gas were opened up.

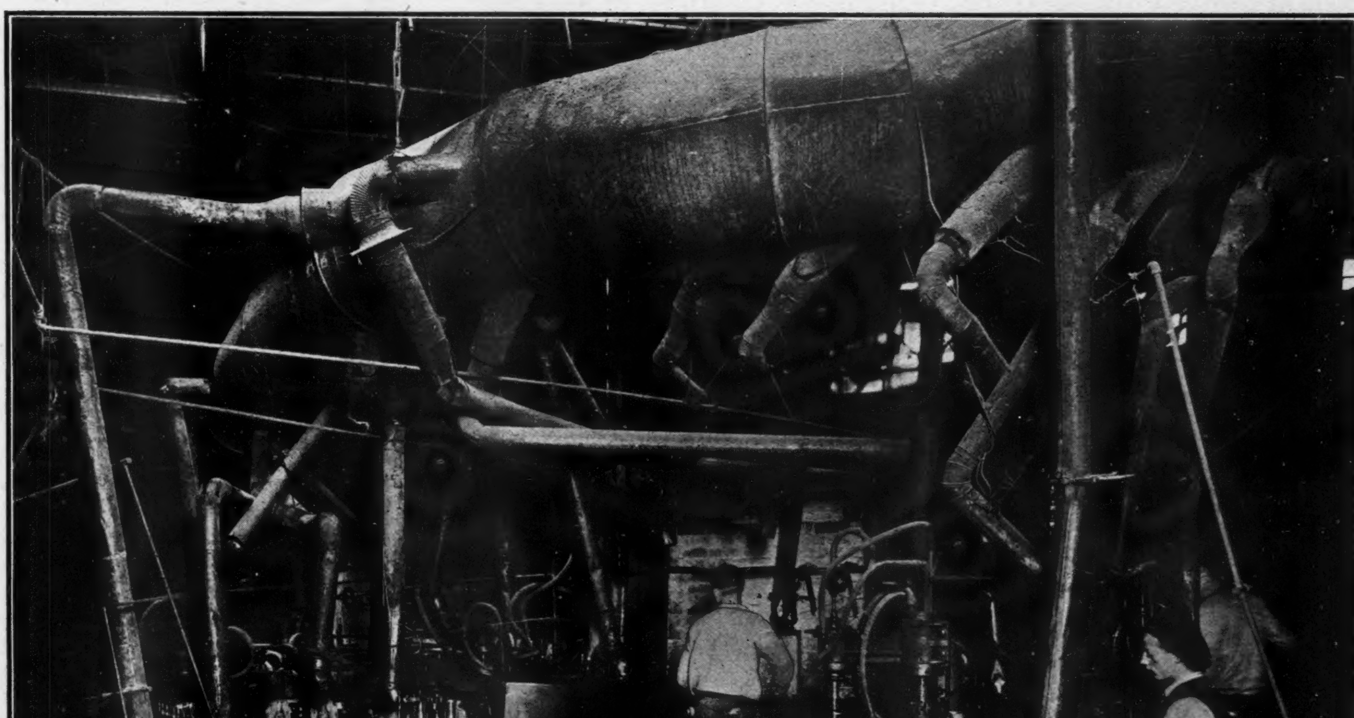
Now, however, a typically modern glass plant involves large initial expenditures in machinery and equipment of different sorts, and to house these properly and to get the most out of them calls for the erection of first-class buildings—fireproof as far as possible. As a consequence, the hygienic circumstances are apt to be much improved and the personnel benefited accordingly. Stress is laid upon this point because it has so often been said that the glass worker's life is a short one by reason of the unhealthful environment of his day's toil. High temperatures in the immediate vicinity of the furnaces and tanks filled with molten glass are unavoidable, but ventilation artificially stimulated can modify this to a marked degree. In short, the hands as a rule react favorably to more wholesome surroundings and are apt to take better care of themselves. The physical hazards of the calling have been materially ameliorated in the last ten years, and the operative's well-being is very largely within his own control.

Bottles were probably the first glass articles blown by the English colonists in Virginia more than 300 years ago; and bottles have pretty much dominated our output of glass ever since—representing to-day something like 45 per cent of the value of our glass production annually. From 1808 to 1870, so it is recorded, an important branch of the glass industry was that engaged in the manufacture of "fancy



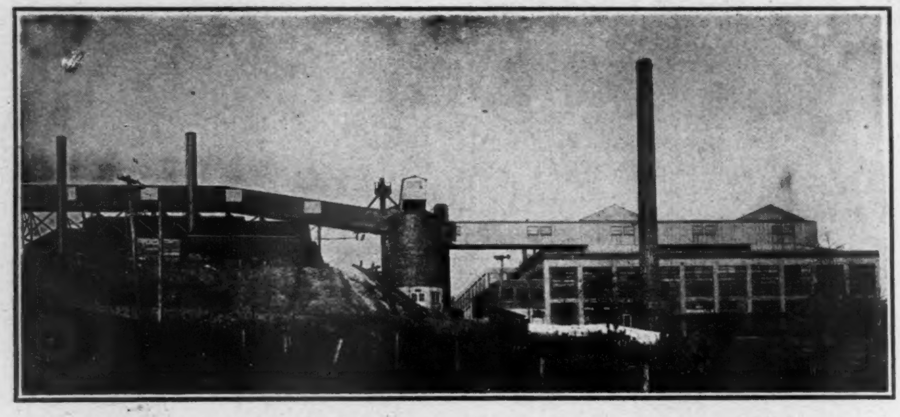
Courtesy of Glenshaw Glass Co.

An automatic bottle-making machine which shifts mechanically the bottle blanks from the first table to the second or finishing table. A revolving disc at the extreme left picks off the completed bottles and delivers them to a conveyor running to the leer. Just above the bottle machine is the automatic feeder, attached to the front of the furnace.



Courtesy of Glenshaw Glass Co.

On the right is a closeup of an O'Neill bottle making machine. The man back of the machine on the right gathers molten glass from the furnace and feeds it into the molds on the revolving table near him where the glass is formed into the bottle-blanks. The boy at the front shifts the blanks to the finishing table and next removes the completed bottles to a stand, whence they are carried by hand to the leer.



The up-to-date glass factory is apt to be a rather imposing looking establishment. In its architectural get-up and equipment it gives evidence of the great strides that the industry has made in the last two decades. The operatives labor under vastly improved conditions, and the quantity and quality of the product reflect the gains made by the adoption of automatic and semi-automatic machinery.

The lungs of an up-to-date glass factory are air compressors. In this manner the impulse energy is secured for the automatic and semi-automatic machines which make bottles, tumblers, jars, etc., with amazing speed and uniformity.

"Imperial" XPV steam driven air compressor (18" and 29" steam cylinders, 20" and 20" air cylinders by 20" common stroke) installed at the plant of the Woodbury Glass Co., Winchester, Ind.

pocket flasks and bottles." They were blown in engraved iron molds and much of the finishing of the neck and mouth was done by hand. With minor modifications the so-called hand-blown bottles were made substantially in the same way until the "nineties," when bottle-making machines were developed that gave every promise of commercial success.

Prior to that, however, the demand for increased production led to the introduction in bottle factories of what is termed the "shop system." Up to then, the blower, with the help of a boy who closed and opened the mold, did all of the work of gathering his glass from the melting pot and forming it into the completed article. A good day's output then ranged between 40 and 42 dozen. Under the shop system the operations were divided among three men: one gathered the gob of plastic glass, rolled and shaped it into a small truncated cone on a slab of stone or a metal plate, and then passed it to the second worker who juggled with it before placing the glowing mass in a mold and blowing it out to the desired form. The third operative smoothed off the neck and otherwise gave the bottle the needful concluding touches. A "shop," coöperating in this fashion, is able to turn out from 275 to 300 dozen bottles in the course of a shift. Men especially expert exceed this.

While the shop system with hand blowing sufficed for a while, the thirst of the American people and the demand for glass bottles and jars of divers sorts imposed a rapidly increasing volume of production. Satisfaction of these requirements was well-nigh impossible because of the lack of an adequate number of skilled workers—the bottle blower, like the glass blower generally, being the result of years of apprenticeship and a fairly long period of practice. This situation inspired the inventor, and in 1896 a machine was brought out capable of making wide-mouth bottles and jars. The apparatus was not automatic, and in some respects it was decidedly crude. Nevertheless it was sound in its mechanical principles.

Four years later, there were several bottle-making machines on the market. Some of these required one, two, or three skilled operatives in attendance; and between 1900 and 1912 equipment was developed that could manufacture either wide or narrow-necked bottles. As a further step in the art a truly automatic machine was evolved. The latter, of various types, has since radically revolutionized the whole bottle-making industry. Its introduction has not only raised the standard of efficiency in glass plants engaged in the bottle branch of the business but the machine insures an ample supply at reasonable prices. Now, by reason of continual improvement, well-nigh any kind or shape of bottle, from one-tenth of an ounce to thirteen gallons in capacity, can be produced. The latest and largest of the automatic machines are such that one of them can make as many as 75,000 quart fruit jars in 24 hours. The same apparatus, adapted to bottle manufacture, can turn out 60 a minute; and where small vials are concerned the output is amplified three-fold. It has been estimated that an automatic machine having a capacity of

50,000 bottles in 24 hours does away with the services of about 54 skilled workmen.

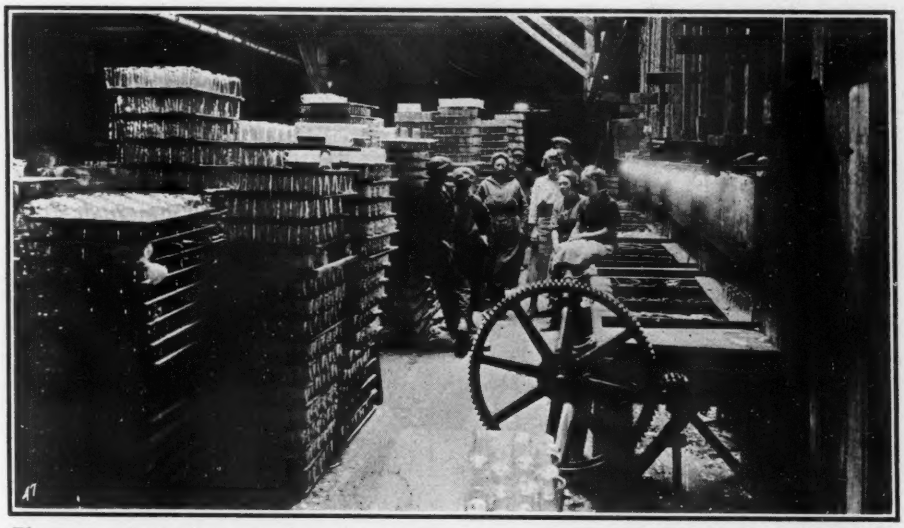
Where two or three men are required in attendance upon the bottle-making apparatus the latter is described as a "hand machine"; and and the semi-automatic machine is one calling for a single trained operative. According to the nature of the installation, this man's work may consist in gathering the molten glass and feeding the molds or it may be confined to transferring the bottle blanks from one set of molds on a revolving table to another on which the finishing molds are installed. And this brings us to the flowing machine, which does away with hand gathering and automatically delivers the exact amount of incandescent, plastic glass into the first series of molds. This mechanism, in the case of milk bottles, for instance, does work that would otherwise have to be performed by thirteen skilled craftsmen.

And now let us go right into the factory and follow a machine-made bottle from start to finish. In place of the human lungs the air compressor furnishes the necessary formative breath and likewise discharges various other functions that make for speed of production and the comfort of the toilers. In an up-to-date establishment, the several ingredients—such as sand, lime, soda ash, and the coloring or decoloring material—are stored in overhead bins whence they can be fed successively into a mechanical mixer mounted upon an electrically-driven car. The amount of each constituent is carefully regulated by suitable scales, and then the operator switches on the current that revolves the drum. When duly mixed, the batch is emptied into a grated chute, situated between the tracks, and travels by gravity right to the admission or filling end of the melting furnace.

To this batch is added from the floor of the furnace room a proportion of broken glass or scrap, known to the trade as "cullet." The ingredients may differ depending upon the type of bottle or container and the service to which it is to be put. The temperature in the furnace varies from 2400 to 2700 degrees Fahrenheit, and it is therefore necessary to employ bricks or "blocks" of a highly refractory composition in building the structure so that it will hold up for a period of months and perhaps years.

Formerly, it was the practice to melt the batch in fire-clay pots set in a cone-shaped furnace, where the contents of some of the pots were brought up to the melting point while the glass in other pots was being withdrawn by the workers. That arrangement was very costly in the expenditure of fuel; it took a long time to render the mixture fluid; and there were limitations of a hampering sort upon the amount of glass that could be handled and made ready for use. To overcome these shortcomings the tank furnace, or "tank" as it is usually termed, was evolved.

The tank makes it possible to provide a continuous supply of molten glass to feed the insatiable automatic and semi-automatic machines. According to the requirements of the factory, and the character of the product, a tank may hold anywhere from 50 to 500 tons of white-hot, viscous glass. This type of



The rear end of a leer, showing glassware ready for removal and stacks of annealed articles awaiting final polishing, and, possibly, decorating.

The firebox or admission end of a leer. In this case the glassware is fed into the furnace by hand. As each metal tray is filled a bell is rung a suitable number of times, and attendants at the distant end operate a hand winch, thus drawing a trayful of annealed ware out while pulling the newly-filled tray into the leer.

The electrically driven car and mixing drum which pass successively under the different bins and gather and mix a batch before dropping the composition into a grated chute between the tracks. The stuff then descends by gravity to the filling end of the "tank" or melting furnace.

A view of a two-way belt conveyor moving finished bottles from a couple of machines to a convenient annealing furnace. The bottles enter the furnace through a port at the right hand side, forming in a row parallel with the face of the leer, and at regular intervals each row is forced rearward by an electrically operated pusher. The whole journey from inlet to outlet of the leer takes several hours.

Above illustrations by courtesy of Glenshaw Glass Co.

This is one of the most unique of the automatic machines. In this type the two revolving tables are mounted one above the other—the blank-forming table being on top. As each blank is formed, its enveloping mold tips outward and over so that the blank can drop right into a mold on the nether table, after which it is swung under a plunger and blown to the full size desired. The lower table a few seconds later pushes the still glowing bottle onto a metal belt connected with the leer. This machine is linked with an automatic feeder.

furnace is rectangular in shape and constructed of firebrick. It is divided into two sections by a crosswise wall rising to a point just below the beginning of the domed top. This wall is pierced centrally near the bottom by a fairly large passage. Into the rear division is charged every hour or so a batch of the basic materials—thus compensating for the glass that is withdrawn at the other end. There is more or less active boiling in the first compartment, and impurities rise to the surface of the seething stuff while the clarified fluid glass settles bottomward and flows through the wall opening into the space forward.

The fuel used may be oil or natural or producer gas; and if oil or producer gas, air compressors are needful for the purpose of spraying and furnishing the required combustible mixture. Flaming jets are projected from a series of ports just below the crown of the tank first from one side and then the other as they sweep over the surface of the glass or batch—continuing their journey by an indirect route to the smokestack.

This alternate and devious movement of the flames and gases of combustion serves to maintain substantially the whole tank at nearly the same temperature while utilizing more effectively a greater percentage of the heat units. Glass so melted is more uniform than that produced by the older pot furnaces and, therefore, lends itself better to subsequent mechanical manipulation. There are two ways by which the syrupy mass is fed from the tank to the bottle-making machines.

In the semi-automatic machine, for instance, the attendant gathers just the right quantity of glass from a convenient opening in the furnace —using a short iron rod or "punty" for the purpose—and drops it into the mold nearest to him. Only long practice makes it possible for him to do this. Where the automatic feeder or flowing device is employed, the molten glass runs right from the tank into a firebrick cylinder from which it is forced down and out by a plunger of refractory material. At the proper instant, the dangling, glowing mass is lopped off by shears, often operated by compressed air, and it is then free to slide down a metal runway arranged so that the gob can be directed mechanically into an awaiting mold. The feeder is commonly functioned electrically and geared with the bottle machine so as to insure a synchronized movement. With the required quantity of glass deposited in the mold, let us see what follows; and to understand this it is desirable that we have a general idea of a bottle-making apparatus.

Most bottle-making machines are dual in their get-up, and consist broadly of two circular, geared tables upon each of which is symmetrically placed a like number of iron molds split vertically and mounted so that they will open and close at prescribed intervals. In the molds on the first table the bottle "blanks" are modeled bottom-side up, and here is where compressed air does more of its helpful work. As the gatherer draws his punty back after filling a mold, in the case of a semi-automatic machine, he trips a trigger which releases air to a cylinder which turns the table through an

arc of one-fifth of a circle—assuming that it is a five-mold table.

At this point a pneumatic plunger descends and seals the top of the mold, while a similarly impelled small piston rises through the base of the mold—the pressure serving to form the neck of the embryo bottle. Next the table swings another 72 degrees, and this time air is forced up through the bottle neck in sufficient quantity to blow a moderate cavity in the body of the blank. At the succeeding station in the circuit the mold opens and the blank is removed by a worker, turned upright, and set in a neighboring open mold on the second or associate table. The fifth or concluding movement on the first table closes the mold preparatory to bringing it adjacent to the gatherer and filler.

On the second table, the first shift shuts the mold, and, if the bottle has a narrow neck, the blank is brought under a gas flame which softens the glass so that it will not break when, at the next stage, the mold is closed at the top by a plunger through which compressed air is forced into the blank to complete the blowing process. At the fourth station the mold opens, and the still red-hot bottle is removed mechanically or by a workman, according to the design of the machine. After the bottle is blown, and before it leaves the second table, it is commonly subjected to a stream of cooling air which chills the mold and promotes the rigidity of the plastic glass. If the molds are not cooled, the glass is apt to stick to them and thus cause delays and losses.

In an effort to eliminate the hand worker, the wholly automatic machine has been devised which does away with the man who, in the semi-automatic machine, transfers the blank from the first table to a mold on the blowing or finishing table. Of course, the automatic feeder is used in conjunction with apparatus of this pattern. To effect the shift, the molds on the blank-forming table are so secured to arms or crank-like supports that they can be tipped or turned upside down at the prescribed moment, thus permitting the blank to drop neck end up into the awaiting open mold on the second table.

And finally, in their more complete development, automatic machines are provided with air-operated pincers which grip the finished bottle and place it on a near-by rack or conveyor. Up to this point the human hand is not required; and well-nigh all of the mechanical movements are brought into play by compressed air. Not only that, but low-pressure air, blown up through gratings in the floor, modifies the radiant heat and adds materially to the comfort of the supervisory force.

Glassware of any sort would be unstable or ill suited to the uses to which it is likely to be put if not subjected to a further treatment after the molding or blowing processes are completed. The ware must undergo an annealing operation to arrest the too-sudden chilling of the surfaces, which would induce internal stresses tending to promote cracking or fracture later on. That is to say, it is essential that the whole mass of the bottle, jar, etc., be cooled gradually from the inside outward. Therefore, the next stage is to move the containers, while still glowing, to an annealing furnace or leer, which has a temperature at the admission end of anywhere from 1000 to 1200 degrees Fahrenheit.

A firebox, heated by gas or fuel oil, is situated adjacent to the mouth of the leer, and from there rearward the temperature drops progressively until it is but little higher than that of the atmosphere without. In the more up-to-date installations, the glassware is placed upon an endless belt of metal latticework which carries the articles slowly toward the exit. This journey from one end to the other, depending upon the character of the commodity to be annealed, takes from three to nine hours—the actual distance covered being from 50 to 70 feet as a rule.

Bottle and jar-making machines differ radically in their complexity and their capacity to produce—some of them carrying as high as fifteen molds or operative "arms." According to the latest official figures automatic machines make fully 45 per cent of all of our bottles, and the rest are turned out mostly by semi-automatic apparatus while a relatively small measure is the result of hand labor. Twenty-one years ago our factories manufactured approximately 1,121,000,000 bottles, jars, vials, etc., and during 1917 the production here was about 5,000,000,000. Since the outbreak of the World War, the business has boomed because we are not only meeting an amplified domestic demand but are rapidly widening the trade in foreign markets where previously we had not ventured to any extent. These achievements would have been impossible but for the peculiarly adaptable characteristics of compressed air. In 1918 we exported bottles, jars, and carboys to the value of $2,781,076, and during 1919 we shipped abroad wares of this nature worth $5,283,655.

The batch bins of a typically modern glass plant. Each bin holds one of the several needful ingredients—these varying according to the kind and color of the glass, and all of them are arranged to discharge into a mixing machine which travels beneath.

So far, we have considered machine-blown ware, but let us see what automatic and semi-automatic apparatus do in the way of pressing glass into the form of tumblers for table service and as containers for jellies, etc. Six years ago we made articles of this kind numbering 216,363,000—an increase of 145 per cent in the course of a decade. Once more compressed air does its effective work, but some of its ways of operating differ from those practiced in the mechanical blowing of bottles, jars and similar articles. There are again two revolving tables geared together to synchronize their movements, and likewise there is set in a circle a number of iron molds, but this time they are not split to open and shut in the manner previously described. Further, an automatic feeder, placed in front of the tank of molten glass, furnishes in rapid succession the billets of incandescent material required for the forming of the tumblers.

Down metal runways, the exact quantity of glass is directed first to one table and then to the other—both tables performing the same operations. Immediately after a billet enters a mold the table shifts until the mold is brought beneath a press cylinder which actuates a piston rod under an impulse of air at 40 pounds. At the lower end of the piston rod is a female unit shaped like an inverted truncated cone, and on top of this is an iron plate having an annular recess. This plate effectually seals the mold and models the rim of the tumbler while the cone is forcing the plastic glass otherwise into the desired form. The cone is cooled by an internal circulation of water.

As the newly-made tumbler is shifted to the two succeeding positions it is carried under pipes discharging air. In this way the plastic glass is solidified while still red hot. At the third point on the table, a plunger, forced upward by air, lifts the tumbler far enough out of the mold so that pneumatically-operated tongs can pick it up and swing it onto a convenient rack or transporter. The tumblers are next placed upon an independent revolving table, where they are rotated once under a series of gas jets. That heat slightly fuses the surface and gives the ware what is known as a fire polish. Automatically, the tumblers are then shunted to the metal belt of a conveyor which moves them steadily onward and into the leer.

At one typically modern establishment, where tumblers are manufactured in this manner, the conveyor is covered over and the ware in transit is subjected to the gauntlet of an array of burning jets. This leaves less heating to be done in the annealing furnace or leer, and effects a substantial economy in the consumption of fuel. Finally, this equipment abridges the time in the leer and, accordingly, permits a greater volume of commodities to be dealt with in a given period.

No word picture of what is accomplished by tumbler presses and bottle-making machines could possibly compass the amazing things performed by these several apparatus. All of them are marvels of mechanical precision and represent a very cunning coördination of many interrelated movements and functions. They have to be such in order to supplant that sharpness of eye and manual skill of the expert workers who used to blow and form all of these commodities. In the case of a two-table tumbler machine, equipped with eight molds on each table, a total of 32 molds must be available—half of them being heated while the remainder are in service. These molds have

to be polished after eight hours of use; and when in action they are frequently blown out by compressed air to free them of any particles of dust or glass.

It should be plain to anyone that has followed this story intently that much of the success of the divers mechanical substitutes for the human worker hinges upon the rather precise regulation of temperatures. The utmost care in this department of the industry is essential to insure the proper flowing of the molten glass and then to maintain its plasticity until the material has taken its ultimate form. According to the composition of the "metal," as the stuff is often called, it will solidify more or less quickly and lend itself favorably or unfavorably to manipulation.

To this end, the gas—natural or producer—is fed at a pressure of twenty pounds to the square inch to the forehearth burners which are interposed between the tank and the mechanical feeder. The forehearth temperature can be controlled to a nicety, and by reason of this the desired viscosity of the glass can be assured at the feeder. If the syrupy glass is not of the right consistency when it enters the feeder, the ejecting plunger will cause the emission of either too much or too little of it—the first entailing a waste of material and the latter the making of imperfect and unmarketable ware.

Manifestly, compressed air is a handy, flexible medium peculiarly fitted to meet the widely varied requirements of the glass manufacturer; but more of this wonderful story of usefulness will be told later on.

50-HOUR TRANSCONTINENTAL MAIL BY AIR ROUTES

J. D. Cudney, chief of the oil engine department of the Ingersoll-Rand Company, of No. 11, Broadway, New York, received a letter from Los Angeles recently, and was astonished to note that it was postmarked two days previously. Inquiry at the New York Post Office revealed that the night mail from Los Angeles had arrived at Salt Lake City in time to be transferred to an airplane flying eastward to Omaha, from where the letter was carried to Chicago by train, and thence by airplane again to New York. The entire postal trip took a little less than 50 hours, the land distance traversed having been about 3,150 miles, which is an average speed of 63 miles per hour.

"WHAT IS VACUUM?"

The following we extract from a full page advertisement of an enterprising company which of course paid well for its insertion. We reprint it here without charge as a concise and indisputable statement of a matter in which our readers are interested. It is made to appear that the only place to find a perfect vacuum is outside the entire material universe, as suggested by our editorial in the present issue.

"If the traffic policeman did not hold up his hand and control the automobiles and wagons and people there would be collisions, confusion, and but little progress in any direction. **His business is to *direct*.**

"The physicist who tries to obtain a vacuum that is nearly perfect has a problem somewhat like that of the traffic policeman. Air is composed of molecules—billions and billions of them flying about in all directions and often colliding. The physicist's pump is designed to make the molecules travel in one direction—out through the exhaust. The molecules are much too small to be seen even with a microscope, but the pump jogs them along and at least starts them in the right direction.

"A perfect vacuum would be one in which there is not a single free molecule.

"For over forty years scientists have been trying to pump and jog and herd more molecules out of vessels. There are still in the best vacuum obtainable more molecules per cubic centimeter than there are people in the world, in other words, about two billion. Whenever a new jogging device is invented, it becomes possible to eject a few million more molecules."

SUPER-POWER ELECTRICAL ZONE FOR FRANCE

EXCELLENT progress is being made in the construction of the high-tension power distribution system which is to make the devastated regions of France independent of direct coal supplies. This French electrical supply scheme will, when completed, have these advantages:

It will make an enormous saving in labor.

It will benefit the small factory and workshop owner.

It will, eventually, reduce France's importation of coal.

The information gathered by the Paris representative of COMPRESSED AIR MAGAZINE is that the plan will be completed by the end of 1921.

Among the towns to first receive current when it becomes available are Douai, Valenciennes, Lille, Cambrai, Laon, Rheims, Epernay, Verdun, Longwy and Nancy. All other cities and villages in this region will be supplied ultimately and the North and the East will be connected with Alsace and Lorraine. The first principal power station will be at Hirson, and later current will be furnished from Gennevilliers and stations on the Rhine. The power to be furnished in the various regions will drive large quantities of compressed air equipment in mines and factories.

An interesting power proposal has been put forth by Calais. Father Piedfort, who is the principal of the Calais Industrial Institute, is the originator of the suggestion. He believes that this important French seaport city may be supplied with electricity at low cost by the utilization of discarded sites. There is in Calais an unused dock, the Bassin des Chasses. It measures about 100 hectares and has a lock between it and the ocean.

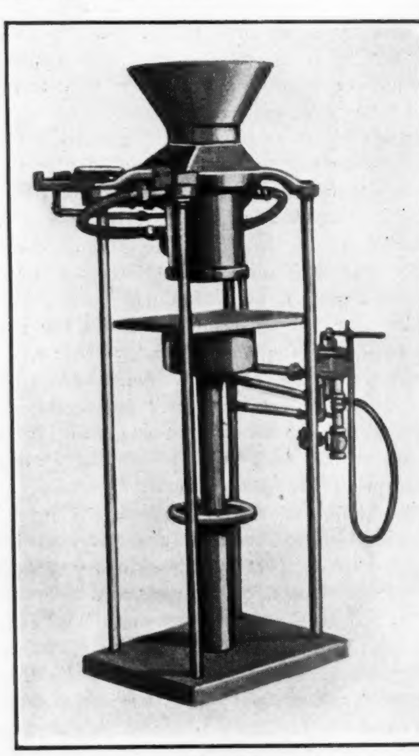
Father Piedfort would have several turbines placed there. These, he states, would generate sufficient power to pump water into a natural and also unused reservoir which is placed at about 125 metres above sea-level. The water thus stored, he is convinced, would be sufficient to drive a power station to serve all **Calais.**

As high tide is never registered at the same time on any part of this coast it is further suggested that a continuous generation of current could be effected if tidal power stations at different points along the coast were joined to central stations which might be situated several hundreds of miles apart.

B. K. R.

RAMS CORES BY MEANS OF COMPRESSED AIR

A LIGHT PORTABLE, adjustable core making machine recently described in *Iron Trade Review* and which is designed to operate with compressed air as a motive power has been developed and placed on the market by the E. J. Woodison Co., Detroit. Referring to the accompanying illustration it will be seen that the machine is of light, plain, substantial construction with a minimum number of parts to wear, get out of line; or need to be replaced or repaired. Four upright rods, firmly screwed to the base serve to support the sand hopper, cylinder and operating mechanism. The table for holding the corebox is mounted on one end of a threaded shaft and is raised and lowered by a hand wheel resting on a circular pedestal attached to the base. The valve for controlling the air line is attached to one of the upright posts as shown.



Air ramming core machine.

In operation, the core box is placed on the table which previously has been adjusted to the proper height. A slight turn of the hand wheel forces the opening in the corebox tightly against the opening in the bottom of the air chamber. A quarter turn of the valve shown attached to the upright rod at the right of the illustration is sufficient to force a stream of sand into the box under pressure. It is claimed that in several plants where the machine has been installed 180 cores an hour have been **turned out with unskilled labor.**

The machine is practical for two part or split coreboxes that ordinarily have to be used in halves, and the half cores either pasted together or the box closed while the core is green. It is difficult to produce a symmetrical core by pasting two halves together, loose sand frequently works into the joint and results in a core that is larger than the original corebox. This contingency is eliminated in the machine under discussion because the box is always closed and the sand forced in through the opening in one end.

MILITARY WATER-BORING IN PALESTINE

MILITARY water-boring is not directly comparable to peace-time practice, owing to the unusual circumstances under which the work must be carried out; the Army control, the inexperience of the men often detailed for the work, the strangeness of the country in which the work must be performed, and sometimes, the unsuitability of the plant provided. It may on the other hand be considered that these difficulties are just those which bring out the best qualities of those in charge of the undertaking.

In an interesting paper read before the Institution of Petroleum Technologists on December 14, 1920, Capt. Paul H. Mangin gave some data with regard to the work done in Palestine. The minor difficulties which the borers had to face were the treacherous nature of the sand in which they were working, and the major difficulties the expectation by the superior control of "miracles" which failed to mature. Although every inch of bore had to be cased immediately after it was drilled, only one of the plants provided had any means of handling casing. At a later date a considerable quantity of tools captured from the enemy was brought into requisition, including a rig designed for use with "free-falls" using the wire line, and a wider range of action became possible owing to the lighter weight of the German and Austrian machines.

In two years men were trained in various capacities for the work, 5,500 feet of hole was drilled of various diameters from five inches to ten inches, and the aggregate daily output from all wells amounted to 1,500,000 gallons. In addition, careful records were kept of the holes drilled, and typical samples of the geological formations and other data retained.

In the hill areas of Palestine, water supplies are scarce and precarious, but in the plains water is plentiful, and can be reached by shallow borings. Between the Egyptian frontier at Rafah and Mount Carmel, 45 bores were completed to depths of from 100 to 300 feet. The geological formations are uniformly unstable, usually consisting of calcareous sands of varying degrees of fineness. Exceptions to this rule are clay beds, deposits of marl, etc., but these are easily dealt with by ordinary percussion boring plant, and it is the normal formations which present much greater difficulties.

Under certain fertile areas it was found there were beds of clay, which held up the water to a considerably higher level than that in which it was found in the sand districts. Salt water was occasionally met with, and water so permanently hard as to be useless. Different wells quite close together sometimes produced fresh and salt water. In general the water is good, with a salinity of 30 parts or less per 100,000, and a total hardness under 25 degrees. A maximum salinity of 200 parts of sodium chloride per 100,000 was met with at El Arish, and a total hardness of 87 degrees was registered at Ludd.

Five kinds of drilling rig were used simultaneously by the Boring Section. The only entirely suitable plant was a hydraulic percussion machine, using a mud flush with a short stroke. Other plants were two Star rigs, one Columbia driller, several German power-driven plants using "free-falls," and a number of similar rigs operated by hand. The successful hydraulic percussion machine has a short rapid stroke, and a continuous stream of mud-laden water is pumped through the hollow boring rods and tools, which keeps the cutting edges free from the heavy sands which would otherwise tend to cushion the blow. The pressure maintained is sufficient to impregnate the porous walls of the bore to a considerable horizontal depth with finely divided clay, which prevents collapse and obviates the necessity of inserting the casing or lining pipe until the bore is completed. It was found possible to drill small bores over 200 feet with this method, in loose and caving formations which with other boring plants collapsed as rapidly as they were drilled.

The Fauck plant was the only one which could satisfactorily carry large diameter casing through the sands. A still greater was the obtaining of a sufficient quantity of water from the finished bore without the entry of large quantities of sand and silt. Excluding the Fauck system, it was often necessary to introduce clay into the bottom of the bore hole to assist drilling. Where the water was shallow this could be put down in the form of fairly hard balls, but where the water was deep this would disintegrate before the bottom of the water was reached, and in this case a small bailer was filled with clay and the clack-valve replaced by a few thicknesses of brown paper, which could be broken out at the bottom.

Where water was plentiful, it was found that small casing would follow a water jet to considerable depths, the jet being coupled to one or more hand pumps by means of one-inch piping, and the casing sinking as the supporting sand flowed with the jet. Where water was not so plentiful, the "Meyer" surface auger system was used, a bore being put down 135 feet with one of these augers. The tool used was twenty feet in length, and made a hole suitable for sixteen cms. inside diameter casing. One difficulty met with was that below 60 to 70 feet deep the auger always tended to deviate from the vertical, owing to the lightness of the rods used. It is considered that with properly designed augers fitted with guides fair drilling might in this way be obtained.

A difficulty to be faced is that the casing must be inserted as soon as the water is reached in sand, to prevent caving in, whereas the auger will only drill clay in the presence of much water, so that where clay and sand alternate, this method of drilling is almost impracticable. It should be noted that where clay is used to assist drilling, it should only be inserted with great care, as surplus clay in the borehole may subsequently be found to clog the sand screens. Captain Mangin considers that a rotary system of drilling, with a fish tail bit and mud flush, would probably have been as successful as the hydraulic percussion rig mentioned, but arrangements which were proposed for the trial of such a rotary plant were vetoed by the authorities.

Many attempts were made to arrive at the proper mixture for the slurry. Too thin slurry does not prevent the caving-in of the hole, and too thick slurry is liable to result in a coating of clay being formed on the sides of the hole, which reduces its diameter and may necessitate re-drilling. It is almost impossible to extract all the arenaceous matter from clay. As a rapid expedient the slurry was generally made thicker than the ideal, and afterwards smaller-than-normal casing inserted.

The sands in Palestine vary through all degrees of fineness, and the largest water supplies are often found where there is a large percentage of calcareous dust. This gives a great deal of trouble, but sometimes clears itself after a time as all the fine material is pumped out and the coarser material forms a second barrier behind the sand screen. Where most of the sand is small in size, the problem of pumping the water so that it has only a small sand content is of great difficulty. In such cases the air lift system is the only complete solution.—*R. H. B.*

THE 1920 IRON AND STEEL BUSINESS OF BELGIUM

AT THE request of our Paris correspondent, the Belgian Government has furnished COMPRESSED AIR MAGAZINE with the following table showing the Belgian imports and exports (in tons) of iron and steel manufactures during the first ten months of 1920, (the latest date to which figures were available at the time the request was made) compared with those during same period of 1913.

Compared with 1919, exports in 1920 are known to show a considerable increase, but it will be noticed that in very few cases do they show an increase over pre-war figures. In most cases exports in 1920 are not more than 35 per cent. of pre-war shipments.

	IMPORTS		EXPORTS	
	1920-Tons	1913-Tons	1920-Tons	1913-Tons
Ingots	21,000	4,000	5,000	200
Blooms	145,000	42,500	5,100	36,200
Billets	93,000	18,000	8,000	89,100
Cast-iron	306,200	517,000	27,100	14,400
Cast-iron goods	3,900	7,100	14,600	20,800
Beams	13,300	1,500	43,500	83,500
Rails	14,000	8,200	37,200	136,400
Sheet iron	29,700	19,600	109,500	161,700
Bars	43,200	39,000	324,000	522,200
Wire	6,600	53,900	35,600	46,480
Nails, rivets	500	800	17,300	34,600
Barbed wire	2,100	Nil	2,400	10,500
Tubes	1,600	12,900	4,600	2,400
Wrought steel	22,500	15,900	48,200	115,880
Rolling stock	115,900	5,100	13,800	108,900
Machine tools	123,800	78,200	52,200	58,000

There is official notice that the Belgian Congo requires great quantities of iron and steel goods, railroad material and many varieties of machines and tools.

A MINER'S GHOST STORY

By FRANK H. MADISON.

A LITTLE TUGGER hoist once threw the fear of the Lord into some Slav and Finn miners at the Colby Mine of the McKinney Steel Company in Michigan.

These miners were repairing a caved sub 100 feet above the main level and the only entrance to the sub was through a cribbed six post raise. A Little Tugger hoist was placed in the man-way set of the raise and was used for hoisting all timbers to the sub. The raise continued past this sub up sixteen feet to another sub, which was only opened fifteen feet on either side of the raise. The miners were working about 30 feet from the raise when one day the Tugger started operating, lowering the wire rope down toward the main level. One of the miners, a Slav, walked over to the raise to see who was operating the tugger. To his great surprise, he found no one around and the rope traveling merrily down the raise.

He reversed the hoist, rewinding the rope, and looked all around for the person who had started up the hoist. He even climbed to the sub above, but found no one around. Much mystified he went back and told his partner. They agreed someone was playing a practical joke on them, and that they would keep their eyes and ears open to catch whoever was playing the joke.

Nothing occurred for about three hours and then suddenly the hoist started again. A swift rush to the raise, a hurried climbing of the raise both up and down failed to disclose the joker.

To the superstitious Slavic mind it was more than a joke, it was positively horrifying to have a machine start up without any visible human agency helping it, and it was with badly shaken nerves that they went back to work. When the thing occurred again late that afternoon and close search disclosed no one, the Slavs were through work.

They climbed down the raise to go up on top.

On the main level they met the mining captain and when he asked where they were going they told him they were finished, that there were ghosts in the sub and they would not go back there. Of course, the captain laughed about it but he couldn't get the men to return, so he changed them to a different part of the mine and the following day sent two Finn miners down to the sub. He told them what the Slavs had said but the Finns told him they were brave men and "no be fraid," and that if the tugger started up they would catch the man who was starting it.

At ten that morning though, when the tugger started up and strict search revealed no man they were a little nervous, and one of them opened his clasp knife and stuck it in the timber near him and the other kept a grip on his pickaxe. About one o'clock, the tugger started up again and the second the air came in both Finns were on the dead run for the raise. When they found no one there and the tugger running, their nerve was broken too and down the raise they went.

Things were looking serious as it would never do to let the miners get an idea the mine was haunted, and the mine captain decided to look into the affair personally.

He found that the Slav operator, who was a great admirer of the hoist, had discovered the hole in the valve chest cap and stopped it up, "to keep dirt out and stop a leak," with the result that pressure built up in that end of the valve chest forcing the valve to open position."

This wrecked the promising ghost story and pointed that

MORAL

"Do not alter machines in the field, all parts, even holes, have a purpose, and if tampered with may call up the ghosts."

SIFTING-OUT THE FLIERS

Among the various problems involved in the development and establishment of practical aviation the human element is perhaps the most serious and exacting. Not only are the operators to be trained to the point of reliability but previous to that there must be a sifting out of those who are physically disqualified so that no time may be lost in unprofitable attempts at training and no avoidable dangers incurred. Tests also are most necessary for would-be passengers, as there are very many who should never be permitted to make any trials in the sky.

The famous military academy of St. Cyr, in France, has established an aerotechnic department ingeniously equipped for both the testing and the training of student aviators and for the quick and economical working out of many problems having to do with flying which can be settled on the normal levels of the earth.

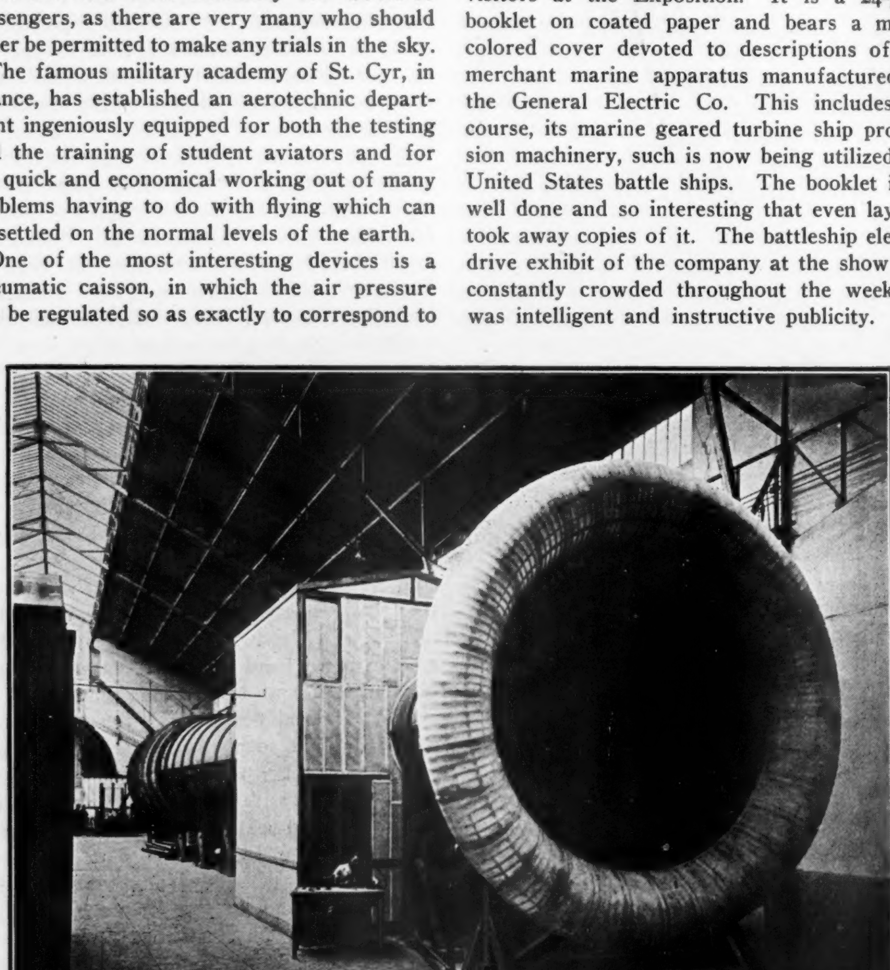
One of the most interesting devices is a pneumatic caisson, in which the air pressure can be regulated so as exactly to correspond to any level in the atmosphere. The student placed inside of it is exposed, in this respect, to the conditions he would encounter in a climb upward to lofty altitudes.

The temperature inside the caisson is likewise under control, so that the occupant may experience just such a gradual chilling of the air about him as he would meet in a climb far into the sky.

Accurate recording instruments take note of his lung action, blood pressure and capacity of resistance to cold; and when he has endured the test and has come out of the caisson, measurement is made of the strength and fulness of his heart beats.

For theoretical great altitudes he is provided with a respirator mask and a tank of oxygen, just as would be the case if he were flying at a level of five miles or higher, where the air is so thin that a man cannot get enough oxygen into his lungs to keep him alive.

The General Electric Company, which maintained a magnificent exhibit at the recent Marine Exposition of the National Marine League in New York, issued at the time of the show one of the handsomest pieces of literature that was dispensed to the thousands of interested visitors at the Exposition. It is a 24-page booklet on coated paper and bears a multicolored cover devoted to descriptions of the merchant marine apparatus manufactured by the General Electric Co. This includes, of course, its marine geared turbine ship propulsion machinery, such is now being utilized for United States battle ships. The booklet is so well done and so interesting that even laymen took away copies of it. The battleship electric drive exhibit of the company at the show was constantly crowded throughout the week. It was intelligent and instructive publicity.



© Underwood & Underwood.

French aviators are tested for altitude fitness by an unusual device in use at the Institute of Aerotechnique at St. Cyr. By means of this tunnel-like affair both pilots and planes are subjected to exact pressure and velocity conditions, artificially duplicated. By means of gages the resistance of a plane or the aptitude of an aviator may be ascertained. Pilots are thereby safeguarded from the dangers of death and stupor through flying at too great heights.

Has the Riddle of the Mystery Towers Been Solved?

These Structures Are Now Admitted to be Something Radically New in Coast Defense, and America Has Played a Prime Part in Their Development

By SIDNEY MORNINGTON

SPECULATION was rife for many months in England while the so-called Mystery Towers rose to an imposing height of nearly 200 feet on the tide-swept beach at Southwick, an unpretentious village not far from Brighton, on the Channel coast. From the start of these massive structures, a while previous to the signing of the armistice, until the first of them was finished and floated clear of its sandy bed about the middle of last September, popular imagination depicted a variety of possible uses to which these ponderous compositions of concrete and steel could be put.

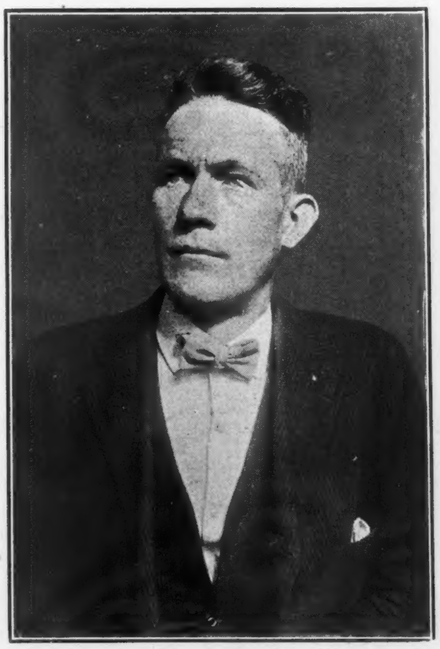
Some of the guessers had it that the towers were to be employed for salvage purposes. That is to say, with their bases firmly planted on the ocean floor, and set on each side of a sunken craft, the towers were to lift the foundered ship on wire-rope slings. Then, by expelling water from their lower chambers, the great bodies were to become buoyant so that they and their suspended load could be towed into the shallow depths of a convenient haven, where the pendant vessel could be dealt with by ordinary wrecking facilities.

Spectacular and superficially convincing as this picture was, the engineers of the British Admiralty had planned, however, for a far more practical application of these semi-submersible structures. It suited the official purpose to let the populace fancy that the towers were for wrecking service, for that self-deception might answer to mislead the foe. As a matter of fact, the real object was to provide instrumentalities that would check the activities of ravaging U-boats and thus lessen the number of ships likely to be sent to the bottom by them.

In other words, the towers were designed to catch the subaqueous enemy unawares and to give him a dose of his own medicine just when he might imagine himself in an unguarded zone. At least, such seems to have been the Admiralty's intention judged by what has taken place.

On the 12th of last September, the first of the twin towers, built at Southwick, was made buoyant by the draining of water from its bottom chamber, and at high tide was towed out into the open sea through a specially dredged channel, coming to a halt off shore not far from the Nab Lightship. There, the lower compartment was again filled with water, and the tower gradually settled until its foundation rested upon the seabed. From that advance position, so it is announced, the tower will form an integral part in a novel amplification of the defenses of Spithead. The exact nature of the armament has not yet been revealed, but there is reason for the belief that the powers of offense will be divided between large rapid-fire guns and torpedo-launching installations.

THE GRIM activities of the submarine have been made possible largely by the manifold services rendered by compressed air. This same flexible medium of power and impulse has been turned to account in devising a type of submergible fort which reasonably bids fair to do much to draw the sting of hostile under-water craft. The secret of the submarine's success has lain in the main in its stealth of approach and its ability to hide beneath the waves until within striking distance of its victim. The submergible fort is designed, in a measure, to use kindred methods of attack and to employ them even to better advantage. Whether the foe be a super-dreadnought, a cruiser, a transport, or a submarine, the subaqueous fort can deal with equal effectiveness with any of them, and be able to bring its weapons to bear when least expected.



Carl L. Lindquist, the inventor of the submergible fort.

So far as existing photographs disclose, the four lower stepped sections of these towers are composed of interconnected concrete blocks, and then, set upon them are two concentric steel tubes or cylinders—the smaller of these being surmounted by an elevated range-finding station or fire-control top. Outwardly, the tower now standing guard off the south coast of England may not improperly be likened to an unfinished lighthouse. The top tubular section is 30 feet in diameter, which gives some notion of the pretentious proportions of the edifice; and tucked away inside of the structure there are mechanisms that make the tower entirely self-contained and capable of generating electric current for the operation of powerful searchlights and other apparatus of a secret nature.

But the question that interests the world at large is whether or not the British Admiralty is bluffing and still hiding the actual use to which this tower and its mate, which is to be floated in the spring of the current year, will be put in time of national peril. Since tower No. 1 is manifestly a submergible body, which can again be made buoyant by the expulsion of water ballast, is there not warrant for the belief that the tower may, if occasion arises, be shifted from its present position to some other point in deeper water where only a small part of the upper section would rise above the tide?

And, again, is there anything to prevent the tower working somewhat like a telescope so that the top tube may be housed within the enveloping cylinder, thus making it practicable to hide beneath the sea? Operating in such a fashion, a defense of this sort could lie concealed until the moment for action, and then appear suddenly and bring its weapons to bear! This may sound fantastic, but there is nothing mechanically prohibitive in it, and there is reason for the assumption that the towers are planned to function in this very fashion.

Looking back to the many unusual agencies brought into being during the progress of the World War, and recalling the part played by the inventor in this field of development, we are justified in asking, Why should the British Admiralty not have set its experts to devising undersea forts? Is it not self-evident how defenses of this sort, placed athwart the paths of hostile submarines, would have been especially effective in holding the Kaiser's sea asps at bay? No matter what the weather, towers of this nature could keep their stations out in the storm-swept sea—silent, alert, and unseen—and be capable of picking up every sound that would betray the oncoming and confident foe. On the face of the records there is much that proves that the Admiralty built the Mystery Towers for service of this character. and, further, it would seem that America contributed to the plan.

About the time America entered the war, there appeared in the popular press a fairly full description of an unusual type of salvage craft consisting, in the main, of great steel pontoons pivoted to rolling bases, and arranged to rise vertically from the seabed ten or more feet above the surface of the water.

The idea being to place these unique vessels alongside a wholly submerged ship and to lift her clear of the bottom in slings when the pontoons were made sufficiently buoyant. Carl J. Lindquist, an American citizen, was the inventor; and he designed that his pontoons or cylinders should move up and down within other tubes, so that a unit would be able to work on a wreck 300 feet down.

As an adaptation of the same principles he subsequently conceived how these perpendicular cylinders or pontoons could be made to act as submarine forts when equipped with torpedoes and guns. The latter weapons to be used when the tops of the structures were elevated above the tide. Note how closely the general features of Mr. Lindquist's invention agree with what has been told variously of the purposes of the Mystery Towers! The resemblance is more than accidental. During September of 1916, this ingenious man of Scandinavian birth applied to the United States Patent Office for a patent on a portable submarine fort, and a while later he tendered his scheme to the Admiralty Board of Invention and Research—receiving in due course of time notice that his "suggestions have now been investigated and are found to be of no practical utility for His Majesty's Service."

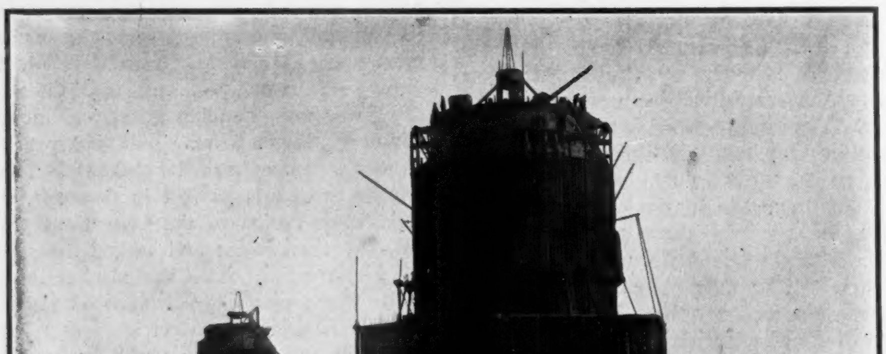
However, the drawing submitted was retained by the authorities. Again, in the first half of 1918, Mr. Lindquist, still bent upon aiding the Allies to combat the submarine menace, wrote to the Munitions Inventions Department, being firmly convinced that his novel under-water defense would be of value. Keep these dates in mind. Now let us see what the Lindquist patent, since issued, covers. As long as the war was on the inventor was prohibited by the U. S. Federal Trade Commission from taking the public into his confidence.

As originally described, the Lindquist submersible fort consisted broadly of three fundamental members, a double-walled tube secured to a large elliptical cellular pontoon base which could be flooded or drained through the expulsive action of compressed air. Similarly, the subdivisions between the walls of this tube were arranged with suitable facilities for the admission of water ballast or its discharge by compressed air. The third member was a second tube, placed within the one already described, and likewise equipped with means for the storage of water ballast and compressed air for the control of its up-and-down movement.

The topmost chamber of the inner tube was to carry torpedoes and launching tubes, and projecting from the peak of this compartment was to be set a periscope which would command an all-around view of the horizon when the rest of the fort lay beneath the surface of the sea.

The central tube, which might be armored where exposed to view, was to have accommodations for a working complement and to carry an oil-driven compressor and an internal combustion engine for the functioning of an electrical generator. In short, when once "anchored" by water ballast at the point desired, the fort was to be provisioned, to be supplied with all necessary operating stores, and thus enabled to carry on without further assistance for weeks running. The main or supporting tube was linked with the elliptical pontoon base by a double set of trunnions, supported by brackets, which were intended to permit the vertical members to swing freely to the urge of ocean currents. Widespread hoops or rings were to be fitted to each of the tubes from which would fall to the base a protecting crinoline of wire netting to halt enemy torpedoes.

As can be readily grasped, a fort of this kind



Two mystery towers at Shoreham, England. The one on the left was towed near the Nab Lightship sunk to bed of the sea, for use in the defense of Spithead. The tower shown in the foreground was not launched.

The first conception of the Lindquist submergible fort was, in effect, a telescopic vertical pontoon pivoted to a submergible base which could be used to raise a deeply sunken ship. The scheme involved using two or more of these salvage units, placed on opposite sides of the foundered craft and linked by steel hawsers passing beneath the vessel. Thus, by increasing the buoyancy of the pontoons at the proper moment, their telescopic sections would rise and lift the wreck in the wire rope slings. Or, by making both the pontoons and their submergible bases buoyant, the salvage apparatus and the ship could be raised clear of the seabed and towed into shallower water—the operation being quite independent of the rise and fall of the tide.

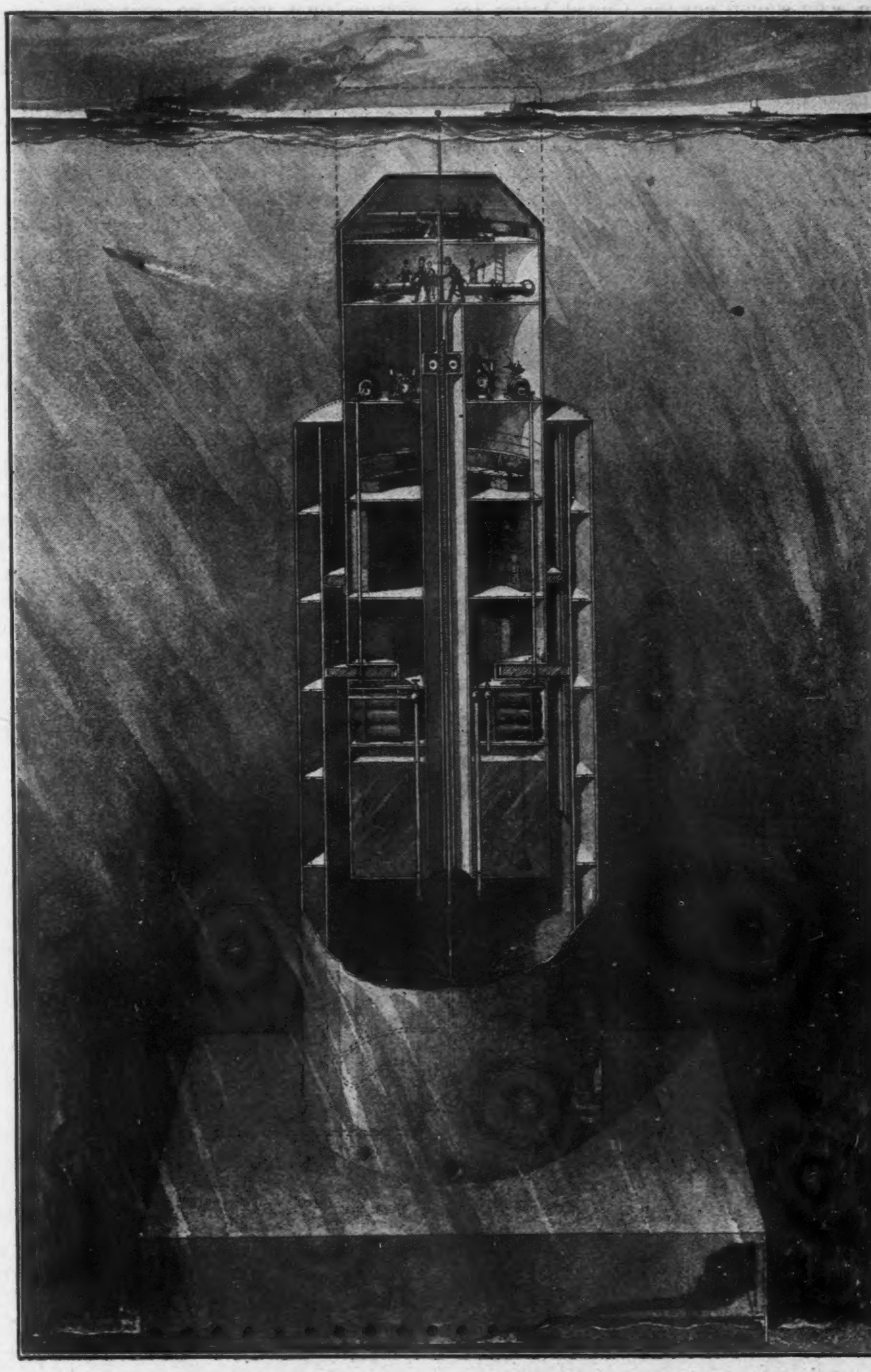
would float freely when the pontoon base and the cylinders were drained of water ballast—the tubes then lying in a nearly horizontal position. In this buoyant state it would be a comparatively easy matter to tow such a structure to any chosen station for service. And having arrived at the place previously determined, the "anchoring" of the fort to the seabed would be quickly accomplished by admitting water to the chambers provided for that purpose in the base and the larger tube immediately secured to it. This would still permit the inner tube to float within the enveloping sleeve of the bigger cylinder; and, agreeably to the soundings, the top of the fighting tube would project for a greater or lesser height above the surface of the sea.

To cause the central cylinder to sink out of sight, it would be necessary only to admit enough water ballast into the compartment at the bottom of this structure to give it negative buoyancy. Its descent would be gradual because, in settling, this cylinder would have to expel water from the central chamber of the major tube—the downward movement being akin to the action of a pump piston. To hold the fighting tube at a fixed depth or vertical position, Mr. Lindquist provided a pair of strong gear wheels which could be locked with an axial shaft, fastened to the lower end of the outer tube, and equipped with rack-like rings to intermesh with the gear wheels.

Further, in order to facilitate the orientation of the fighting tube for the purpose of bringing the torpedoes to bear upon the target, the inventor placed two big horizontal gear wheels, pivoted on opposite sides of the smaller cylinder, where they could engage a series of vertical ribs attached to the neighboring inner wall of the main cylinder. By turning these wheels, the inside tube could be rotated and the torpedo ports thus swung into line of fire. It would not be necessary for the fort to have more than its periscope out of water to enable it to use its torpedoes effectively.

If, however, the fort carried guns, they would be brought into play by raising their platform above the waves. To accomplish this there would be expelled from the ballast compartment of the central tube sufficient water to give the needful measure of buoyancy, and then, with the locking gear wheels released, the armed tower would emerge. There would be no danger of it sliding free of the enveloping supporting main tube, as stops are designed to check the upward travel at a certain stage. As a matter of fact, the admission of water ballast and its expulsion by means of compressed air introduces nothing novel, for we all know how the same agencies are used in manoeuvring a submarine; but in the case of the Lindquist submergible fort the control of vertical movement by the juggling of air and water can be carried out with greater nicety and the telescoping tube held with ease at any prescribed depth.

Such, broadly, is the type of subaqueous defense that Mr. Lindquist submitted to the British authorities before they undertook the building of the Mystery Towers; and if the two surmounting cylinders of these towers are arranged to work along somewhat similar



The top of the telescoping cylinder is heavily armored so as to withstand attack by guns, torpedoes, and aerial bombs. The uppermost compartment would be equipped with two large rapid-firing guns, the ports being sealed during submergence by sliding covers operated by compressed air. The second compartment is the torpedo-firing chamber, and the launching tubes would be serviceable either when above or below water. Compressed air would be the expulsive medium and the actuating agency for the torpedoes. The third compartment is the machinery space in which would be placed oil-driven air compressors and an electric generator. The two small motors at the extreme right and left drive the vertical shafts which turn two big gear wheels engaging the ribbed inner surface of the main cylinder, and in this way the armored tube could be rotated so as to bring the guns and the torpedo tubes to bear upon the target. The fourth compartment contains the living accommodations. The fifth compartment is the store-room. The sixth compartment holds tanks for fuel oil and fresh water, and storage batteries to furnish motive energy when the other machinery is shut down and current for electric lighting. The seventh compartment carries an extensive battery of flasks for the storage of air under high pressure. The eighth compartment is the main water ballast tank of the telescoping tube. To elevate the turret above water it is only necessary to force a sufficient quantity of ballast outboard by means of compressed air.

lines, it is not difficult to see how the English structures may be expected to function when located in water 160 or 170 feet deep.

These towers have reinforced concrete bases of octagonal shape which are, in substance, pontoons capable of being flooded or drained by means of valves and pumps; and the system in its entirety would seem to differ from that devised by Mr. Lindquist principally in the rigidity of the whole tower and the absence of any provision which would allow the superstructure to swing to the tide. This feature is unnecessary in the British development of the idea; and the American inventor frankly acknowledges that the change has engineering advantages.

Now, if Great Britain has seen fit to embark in this development of submarine de-

fense, why should not the United States follow suit. It calls for no great stretch of the imagination to picture numerous points along the seacoasts where submergible forts might fittingly augment shore batteries and serve the purpose better than mine fields. A chart of the Atlantic seaboard from Cape Ann south will show many positions—some of them several miles off shore—where defenses of this character might be placed in waters ranging from 100 to 200 feet deep.

In a general way, it is fairly well known how successful American scientists were evolving microphonic and hydrophonic apparatus for the detecting and the locating of subaqueous sources of sound. The only trouble experienced in using the more sensitive of these instruments was the need that the listening craft stop her engines and drift so that her "ears" could pick up the tell-tale vibrations.

With a submergible fort, on the other hand, there would be no propulsive machinery to disturb those on the alert; and these silent sentinels of the deep, by means of their microphones, could catch the faintest trace of the foe when afar, and, by noting the growing loudness of the betraying propeller beats, etc., determine certainly his stealthy approach. Not only that, by linking two or three of the forts telephonically or telegraphically, they could quickly plot the enemy's position and follow his every move thereafter within the audible zone. And all the while that the hostile submarine was advancing those aboard of her would have no means by which to discover the hidden defenses. The forts, with their upperworks suitably camouflaged, could lie fifteen or twenty feet below the surface of the water and probably escape discovery from aloft—supposing that aircraft should be operating in conjunction with submarines.

From the physical nature of things, San Francisco offers a well-nigh certain point of attack if an enemy threaten the United States from the Pacific Ocean. Again, it would be extremely hard, if not impossible, to establish mine fields that would serve satisfactorily to block the Golden Gate if a determined flotilla of hostile submersibles were bent upon forcing a way into San Francisco Bay. Therefore, it is suggested that perhaps the whole situation might be changed materially for the better if the land batteries be supplemented by an arc of portable submarine forts, based upon the Farralone Islands, 30 miles off shore, and bending back toward the coast. The water within this area averages about 150 feet in depth, and would present no serious obstacle to the establishment of such a protecting line.

Placed a mile or so apart, and intercommunicating, a series of submergible forts, armed with heavy rapid-fire guns and large torpedoes, would be capable of dealing effectually with any type of menacing naval vessel. The torpedoes could sound the death knell of the biggest of armored ships while the rifles would suffice to combat submarines, destroyers, scouts, and light craft generally—not to mention transports, oilers, and supply ships. Where defending surface vessels could not hold their stations because of the weather, the submarine forts would be continually on guard and able to give battle.

Finally, the portable submarine fort can be shifted quickly if, for strategic reasons, it be desirable to change its location. Thus, within limits set only by the depth of the water and the maximum vertical length of the structure, it would be entirely feasible to move a defense of this nature from place to place in order to befuddle an attacking force and possibly to neutralize the activities of spies and hostile airmen.

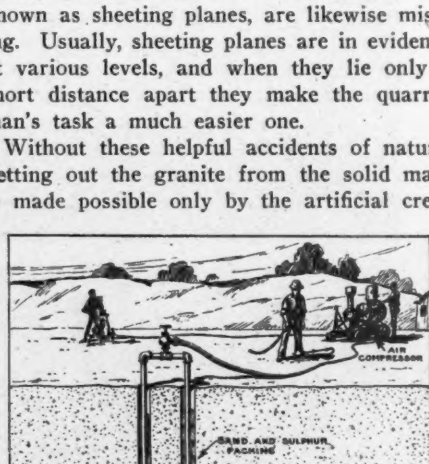
From what we know now of the Lindquist patent is there any longer a reasonable doubt about the service for which Great Britain's Mystery Towers were built?

NOVEL USE OF COMPRESSED AIR IN QUARRYING

COMPRESSED AIR as a cleaving agency has been suggestively demonstrated down South; and success there may give a helpful hint to other quarrymen. Not far from Atlanta, Georgia, there stands out a great dome of granite from which is obtained large quantities of building stone and paving blocks. This particular formation differs notably from other outcroppings of this well-known material inasmuch as there is a remarkable absence of "sheeting planes" and "joints."

Joints, as the term is used geologically, are those open fractures that are ordinarily present in rocky formations, and they are commonly found spaced at intervals varying from a few inches to a number of feet. More often than otherwise the crack runs in a vertical direction. In the Lithonia district, near Atlanta, it seems one may walk for hundreds of feet over the bare rock without discovering the faintest indication of a joint. Similarly, those other open fractures spreading approximately parallel with the rock surface, and known as sheeting planes, are likewise missing. Usually, sheeting planes are in evidence at various levels, and when they lie only a short distance apart they make the quarryman's task a much easier one.

Without these helpful accidents of nature, getting out the granite from the solid mass is made possible only by the artificial creation of sheeting planes, and here is where the force and the peculiar penetrative property of compressed air come to the rescue. According to Mr. Oliver Bowles, of the U. S. Bureau of Mines, the method employed on this Georgian granite may be copied to advantage wherever a kindred condition prevails—incidentally, much blasting powder may be saved while achieving decidedly superior results.



Sketch showing mechanical arrangements for quarrying by means of compressed air.

The procedure is a simple one and is started by the drilling of two holes, close together, of about three inches in diameter and penetrating the rock perpendicularly to a depth of eight feet. When these drill holes are finished, a spoonful of black blasting powder is dropped into each hole and tamped with clay—the charges being arranged so that they may be fired simultaneously by means of an electric connection. These explosions serve to start small fractures reaching out at right angles into the rock from the bottoms of the drill holes. The Lithonia outcropping, like other granites, splits easiest in one direction, and this "rift" is in the horizontal plane.

Following the initial shot, the clay tamping is softened by water and removed. Next, a second charge, just a little larger than the first one, is placed in each hole, tamped, and fired in unison with its neighbor. This operation may be repeated a number of times, with gradually increasing blasting charges, until the quarryman is satisfied that the radiating fractures have widened sufficiently for his purpose; and one familiar with the process can tell by the jar on the rock beneath his feet, at each explosion, how far the cleaverage has spread. When the horizontal fissure covers a circular zone in the granite having a radius of from 60 to 80 feet, then the use of powder is discontinued, and the next step is to bring compressed air into play.

An iron pipe, an inch or so in diameter, is set into each drill hole, and the surrounding space sealed with sand and melted sulphur to prevent the escape of air when pressure is applied. To these pipes connections are made from the air-compressor equipment which ordinarily furnishes motive power for the quarry drills. At the right moment air is driven down through the pipes into the rift area previously made by the powder charges, a pressure of about 100 pounds being used. A few moments after air is thus injected into the artificially created sheeting plane, a cracking sound is heard, and the audible vibrations extend until a fracture appears on the flank of the rocky dome, from which the air escapes. In this manner a sheeting plane is formed that may cover an area of from one to two acres!

As explained by the mineral technologist, it is really not hard to understand how an air pressure of but a hundred pounds to the square inch may accomplish a task of such immense proportions. Even if the pressure of the air should drop 50 per cent. through leakage or other causes, still we must bear in mind that the total upward pressure on a circular surface of rock 120 feet in diameter would represent a thrust of more than 40,000 tons. On the other hand, the actual weight of the overlaying granite, eight feet thick, would amount to

only 7,200 tons, in round figures. Therefore, the lifting and cleaving pressure would be just short of six times that of the primary superimposed burden; and practice has shown that this penetrative impulse is ample to increase the fracture previously started by the explosions.

With the sheeting plane completed, the eight-foot layer of granite provides material enough to engage the attention of many workmen for a whole season. In this, however, compressed air is used only for the drilling of holes, which are placed five inches apart and sunk to a depth of five inches—the splitting by cross fractures being effected by "plug and feather" wedging. In this way, masses of granite eight feet wide, eight feet through, and many feet long are broken out, and these are afterwards subdivided according to requirements. One solid piece of rock was observed which was eight feet thick, seven feet eight inches wide, and 370 feet long, without a single cross fracture, and probably represented a total weight of 1,870 tons. Plainly, the procedure at Lithonia makes it practicable to obtain, if desired, exceptionally large blocks of solid stone.

It should be understood, of course, that compressed air would not be of service in dealing with rock ledges that are intersected by numerous joints, and this is the condition that more often prevails in the run of quarries.

WHO HAS EVER SEEN RADIUM

Radium is a metal that is described as having a white metallic lustre. It has been isolated only once or twice, and few persons have seen it. It is ordinarily obtained from its ores in the form of sulphate, chloride or bromide, according to the United States Geological Survey, Department of the Interior, and it is in the form of these salts that it is usually sold and used. These are all white or nearly white substances, whose appearance is no more remarkable than that of common salt or baking powder. Tubes containing radium salts glow mostly because they include impurities which the radiations from the radium cause to give light. Radium minerals are very rarely, if ever, luminescent.

APPLYING PAINT AND CEMENT BY COMPRESSED AIR

By F. H. SWEET.

THROUGH the development of paint guns. sprayers, and atomizers, for applying paints and protective coatings by the use of compressed air, rubber hose is now used very extensively. Painting with mechanical appliances for concrete and masonry surfaces, structural iron work, bridges, ships, mesh-wire factory fences, tanks, castings, machinery, car trucks, underbodies and other large equipment has been a recognized method for several years, and has generally superseded the hand painter.

With the modern paint gun the work is done when wanted in a remarkably short time, and with little or no interruption of business, without depending on a large labor force and at the lowest possible cost consistent with a thorough, durable job.

The early difficulties, such as loss of paint, excessive scattering and spattering over surfaces not to be painted, lack of control in the wind, and volatilization of the paint oils while passing through the air have been overcome by the perfection of ingenious patent nozzles and the provision of special full body oil paints peculiarly adapted to the purpose.

With an ample length of rubber hose and a twelve-foot extension arm, scaffolding and swing-staging can be dispensed with very largely. Out of doors one man and a helper can cover from 1,000 to 2,000 square feet per hour, multiplying the labor value from eight to ten times. As compared with the hand method, a saving of approximately $1.50 per gallon can be effected. Indoor painting jobs can be done at the rate of 1,000 to 1,600 square feet per hour.

The right paint applied to factory interiors by this method will conserve much light, thereby saving electric current, eyesight and daylight working hours. It gives a smooth, fine, hard, dirt-resisting coating, having neither the chalky whiteness that absorbs light and quickly becomes dirty, nor the glossy surface that causes a blinding glare or dazzling flicker. It diffuses light as it reflects it, and fills the interior with a soft, even radiance. Moreover, a film of paint can be built up in one operation that is the equivalent of two or three hand brush coats.

The method is equally efficient on any surface, from smooth wood finish to the roughest masonry, and can be used to special advantage on cast stucco, rock-faced walls, rough lumber, brick-work with recesses, broken-down masonry joints, surfaces under eaves, lattice work, structural steel, and all places inaccessible to a brush. This is because the perpendicular application of the paint is certain to penetrate voids better than brushing across the surface.

An efficient brushing action by the powerful compressed air jet is of advantage for cleaning dirty surfaces and reaching corners and crevices for which the hand painter's implements, the wire brush, putty knife and cloth, are inadequate.

A pneumatic painting outfit consists essentially of a paint tank with the necessary valves, gages, etc., a motor-driven air-compressor, a nozzle or brush and the rubber connecting hose for paint and air. The paint, ready for application, is poured into the tank. An agitator, operated by hand or compressed air, is available for use when necessary. A compressed air line leads to the tank, with a branch line for air and paint from the tank to the nozzle.

Sometimes the former is ordinary ⅜-inch heavy air hose, while the latter is ¼-inch flexible metal-lined oil suction hose, having coiled copper-steel wire embedded in the wall to give it strength and rigidity. The lining, friction and cover of this hose are especially compounded to resist the action of the oil and paint, as it is important that the rubber shall not flake or peel off and get into the delicate orifices of the spraying nozzle.

The adhesion of the rubber friction must be especially strong in order to retain the wire firmly in place. Special paint hose, three, four and five ply, is also made with internal diameters of ⅜, ¾, ½, 1 and 1¼ inches, having a ply of seamless braided material over the plies of duck, with a rubber cover over this, so that the structure of the hose is held intact, preventing the duck from unwrapping and coming apart after long contact with oil and paint.

Many of the leading companies are employing these pneumatic painters for their buildings, factory interiors, etc., and a number of them use a special equipment with a compact nozzle resembling a pistol and trigger operated to paint the inside of pneumatic tire casings with soapstone paint. For whitewashing and applying cold water paint to factory interiors, where power is not available, a double-acting

© Galloway, N. Y.

Spraying room, Packard Motor Car Company, Detroit, Mich.,—Spraying fender and radiator shell.

cog-geared spraying machine that operates by hand can be utilized to excellent advantage.

The pneumatic spraying principle has also been applied in building. By means of a special gun, side walls and ceilings are plastered, foundations and floors are damp-proofed, and concrete structures are water-proofed, with a coat of pure asphalt compound, applied at normal temperature and under high pressure.

This hermetically seals the surface and protects the plaster against water damage, stain, cold air infiltration and the lime sulphite salts in concrete which cause plaster to decrystallize. Over this a coat of rock grit, also gun applied, makes a scratch coat that requires only a finish coat of plaster in order to give a ceiling of excellent whiteness for light conservation or ideal for decorating. Side walls prepared in this manner and given two, instead of the usual three coats of gypsum hard plaster, afford complete insulation, overcoming all sweating and condensation of moisture. For applying the scratch coat, sand-blast hose is used, having a heavy lining of rubber to resist the cutting action of the rock grit.

With the asphalt gun, concrete structures such as basements, reservoirs, bridge decks, etc., are water-proofed with asphalt compound and built out to sufficient thickness with mastic or membrane. Damp proofers are also applied to foundation walls that are to be furred and to cinder-fill mixtures under matched flooring. The gun cleans the voids, fills them full of asphalt and builds out in an even, laminated coating. Speed renders this method advantageous for quick construction.

Reversing the arts of war, the destructive principles of gun-fire are being employed in the constructive arts of peace, and a cement gun, much like the paint and asphalt guns, is being used for rapid-fire building in England. At Southend-on-Sea a house-building company is putting up houses having wooden frames covered with tar felt and wire meshing. A cement gun is used to spray prepared cement from a large hopper to cover the meshing. In this way 15,000 square feet can be laid in eight hours.

These modern methods in building and structural maintenance depend in large measure upon flexible rubber hose for their efficiency. And confronted as the whole world is by such a serious shortage of houses, it seems likely that these devices which save time and labor, speed up production, and save expense, will come into general use.

FOR SALE—ONE RAILROAD ALL BOXED TO SHIP

A business man recently returned from Europe is authority for the statement that there is packed for shipment at a European port one railroad, narrow gage, with 34 locomotives, 180 open freight cars, 50 closed cars with windows, on the caboose order, trucks, etc. There are a total of 256 cars of different types, a locomotive round house, turntable and all other necessary equipment to operate the road, including 50 miles of rails.

These railroad materials were built originally for a construction line to be used in the laying down of the celebrated Bagdad railway, but which was never completed because of the war. It is said to be suitable for a large mining concern, or lumber company, and to be especially suited to the needs of a sugar cane plantation. Our informant tells us it would cost more than $2,000,000 to replace such a railroad today, but that this one can be bought for about $300,000.

TEMPERATURE AND HUMIDITY CONTROL FOR INDUSTRIES

ONE OF THE few instruments which absolutely control both the temperature and the humidity of the air is that developed at the Forest Products Laboratory, Madison, Wisconsin. For several years this apparatus has maintained in the laboratory wood-parts storage rooms the typical climatic conditions found in various parts of the United States, ranging from the hot, moist climate of the South to the cold, dry climate found in the mountain regions.

The same type of instrument also keeps the wood-working rooms at the laboratory at uniform temperature and humidity year in and year out, with the result that the wooden articles manufactured here give the minimum amount of trouble afterwards from warping and checking, and the shop conditions are healthful and comfortable to the highest degree. These instruments have required very little personal attention since they were installed.

The principle upon which the laboratory automatic humidity-control apparatus works is that of cooling the air to the dewpoint temperature for the desired atmospheric condition, saturating it with moisture at that point, and then heating it without addition of moisture to the required room temperature. For any given room temperature, it is possible to get any humidity desired, simply by choosing the temperature at which the air is saturated.

The apparatus consists of a small cabinet, or chamber, through which the air is drawn as often as it needs to be conditioned. The conditioning chamber contains water sprays whose temperature is kept constant by a mixing valve. These sprays suck in the air by their own action, cool it to the temperature at which it should be saturated, and give it all the moisture it can hold.

As the air leaves the chamber, it is heated to room temperature by coils, whose steam supply is controlled by a thermostat located in the outlet. Thus when the air is drawn into the chamber it may be too hot or too cold, too moist or too dry, but the apparatus automatically humidifies or dehumidifies it and brings it to the correct temperature before allowing it to pass again into the room. Both in the storage rooms, where the air needs conditioning very infrequently, and in the workrooms, where it is completely changed every ten minutes, the recording instruments show that the atmospheric conditions have varied to only a slight extent throughout a three-year period.

This method of air conditioning was developed primarily for woodworking shops and wood gluing, finishing and drying rooms. It is adaptable, however, to numerous other industrial plants, including textile mills and chemical, foodstuff, and tobacco factories, in which close control of atmospheric conditions would be beneficial to both the material being manufactured and the health of the employes. It is practicable wherever there is a supply of cold water and steam heat.

An unusual vessel has been constructed for the Las Palmas oil-fuel supply station by Messrs. Smith's Dock Company Ltd. of North Shields. It is 260 feet long and has a deadweight of about 6,000 tons. The chief feature of the construction is the extensive use of corrugated plating, which has largely resulted in the elimination of frames, stiffeners and knees, and a resultant saving in steel estimated to amount to over 300 tons. The corrugations are two feet, one and one-half inches in radius and lap together for three and one half inches beyond the semicircle.

It has been the experience of the R. A. F. in Palestine and Mesopotamia, where atmospheric temperatures are generally quite high, that water-cooled engines almost invariably boil their water away, whereas air-cooled engines continue to work. The explanation offered is that an air-cooled engine will continue to function at higher temperature than that at which water boils away.

© Galloway, N. Y.

The delicate work of airplane makers—Wing construction, in the Glen L. Martin plant, Cleveland. Enameling part of wing with a paint spray.

Compressed Air in the Chemical Industries

Its Use Becoming More General for a Wide Range of Operations Resulting in Increased Economy. Agitation, Oxidation, Filtration and Mechanical Conveyance of Materials among Important Uses

By FRANCIS M. TURNER, JR.,* and CHARLES F. McKENNA, JR.†

IT IS NOT so much our intention in this article to solve any particular engineering problems in the use of compressed air in chemical manufacturing operations, or to give any exact engineering data, as it is to outline the main uses for which compressed air is employed to-day in plants using chemical processes, and to explain in some detail the nature of these applications. It is out of the question to mention every purpose for which compressed air is used in such plants: rather, we will confine this article to the outstanding uses, which are of most interest both to the chemical engineer and to those interested in the manufacture and sale of air compressing equipment.

Even among those uses of compressed air in chemical plants which are generally recognized as standard practice there is need for thoughtful study on the part of chemical engineers. Were a survey made of a large number of present manufacturing methods, with regard to the systems employed for the elevation and transference of liquids used in the processes, it would be found, we feel confident, that there are many cases that could be added where the use of compressed air for such purposes would introduce a considerable economy. Also, it would certainly be found that in many cases at the present time compressed air is not being used under conditions of maximum efficiency.

It would seem obvious that the manufacturers of air compressing machinery could properly undertake research along these lines, as they would profit directly from any new developments in the use of compressed air.

As is well known to anyone in touch with the industry, mechanical operations in any chemical plant are not confined to any one type, but are very general, including among other things, elevating and transporting liquids, filtering, agitating, decanting, mixing solutions, producing a continuous supply of water for cooling or other purposes, etc. (We have purposely mentioned those operations in which compressed air plays a part). Yet in plants where these operations are duplicated over and over again it will often be found that there is absolutely no standardization. The same thing will be done in two, or possibly twenty different places, in the same plant, in quite different manners.

Sometimes there is some good reason for this, but more frequently it is simply due to the fact that the plant is the result of a gradual and irregular growth, and different types of equipment were installed at different times. Some of the contributing factors to this have been: (1) many plants started or expanded during the war period when one had to take whatever types and makes of equipment one could get; (2) works managers and other plant executives change, and each man has his own ideas and prejudices about such matters; frequently, we regret to state, a new man will vary the type of equipment for no good reason, except to assert his own independence; (3) the impulse to experiment and to see if a good installation cannot be made still better.

In the following paragraphs we will deal with a few important uses in some detail. We have confined ourselves to those uses that are peculiar to industrial chemical plants. We would point out, however, that chemical plants use compressed air for many other purposes which are similar to the same uses in non-chemical plants.

Some of the more important applications are:

(1) Elevating liquids—especially strong acids.

(2) Intraplant transportation of acids, alkalis, oils, solvents, dye liquors, tanning liquids, etc.

(3) Operation of filter presses and other filtration apparatus.

(4) Agitating, aerating and mixing liquids.

(5) Oxidizing and bleaching processes.

(6) Operating various types of furnaces, kilns, etc.

Elevating Liquids

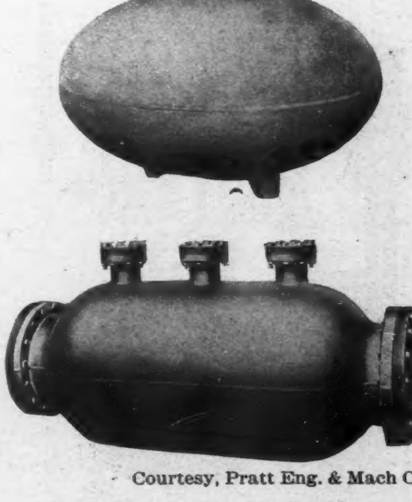
In industrial chemical operations acids and other liquids have often to be elevated to the tops of towers, down which they are allowed to flow to absorb vapors or to accomplish some reaction. Pumps are unsuitable for this work, as a rule, because of the corrosive action of the liquids on the moving parts of the pumps, and because of the frequent high density of the liquids.

The equipment for using compressed air falls into two classes: air lifts and *monte-jus* (which are also called acid eggs, blow cases, blow boxes, acid elevators, etc.) the latter being divided into non-automatic and automatic types. It is a nice problem in chemical engineering to decide just which system is best under any given set of conditions. *Monte-jus* are more economical of air. They require approximately the same volume (figured at the working pressure) except for a slight loss at the exit. The air lift, however, is cheaper as to first cost. Air lifts can be had for approximately $15.00 and good *monte-jus* often cost from $200 to $300.

The air lift is particularly attractive in those cases where no excavation is necessary, for instance, when the bases of the towers are elevated above the general level of the plant. The drop should be at least 50 per cent. of the height, which calls for considerable excavation in most cases. The greater the drop, the less the consumption of compressed air.

In some cases a non-automatic *monte-jus* can well be used, chiefly when the flow is not rapid and a small tank at the top and another small tank at the bottom of the tower will suffice; for instance, a 60 gallon tank at the top and one of the same capacity at the bottom, and a fifteen gallon *monte-jus* or acid egg. The *monte-jus* works as follows: It will be seen from the illustrations that it has three openings. The inlet valve is opened and the acid allowed to flow in from the lower tank. Then the inlet valve is closed and the valve opened admitting the compressed air, which forces the acid up the delivery pipe to the top of the tower. The operation is repeated indefinitely.

This type of equipment possesses the disadvantage of requiring the constant attention of an operative. The valves have to be kept in good order so as not to stick. In spite of all care in manufacture *monte-jus* often burst with disastrous results. Such *monte-jus* are variously constructed of acid resisting iron, lead lined iron, chemical stoneware, stoneware armored with iron, etc. The pressure in pounds per square inch varies from 50 for a small *monte-jus* (say fifteen gallons) to fifteen for a 525 gallon apparatus. The *monte-jus* are tested to a higher pressure by the mak-



Courtesy, Pratt Eng. & Mach Co.

Two types of monte-jus or acid egg.

*Technical Editor, Chemical Catalog Company, Inc.

†Assistant Technical Editor, Chemical Catalog Company, Inc.

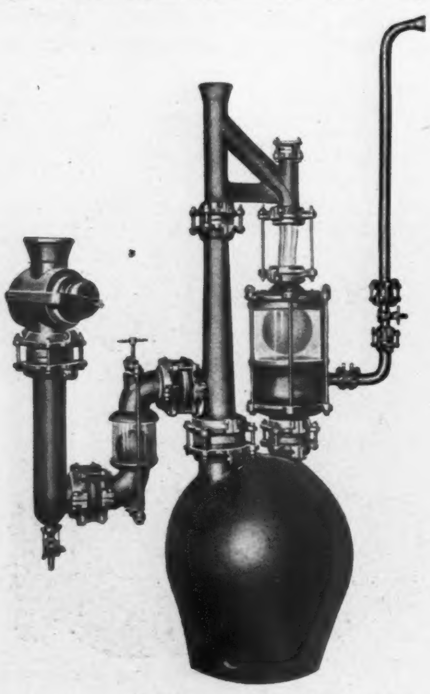
ers. The working pressure should never be exceeded.

Every compressed air line leading to a *monte-jus* should be provided with a good gage, with the maximum working pressure clearly marked, and there should be a safety valve set to blow off at this pressure, which should be inspected at frequent and regular intervals. The egg itself should be in a pit, or a strong timber case, which is usually convenient, as it must be below the level of the supply tank anyhow. The diagram shows a typical installation, for instance for a nitric acid recovery tower handling about eight gallons per minute.

There are a number of excellent automatic *monte-jus* on the market. The illustration below shows the "Plath" elevator made by the General Ceramics Company. In this type the operating device consists of an accurately ground hollow stone-ware ball, which has an apparent specific gravity less than 1.0 and will, therefore, float in practically all the usual acids. The ball moves freely in a cylinder provided with an upper and lower valve seat ground to fit the ball.

When the apparatus is empty the ball rests on its lower seat and, by its weight, closes the small compressed air inlet. The liquid enters through a check valve (on the right of the illustration) and fills the apparatus to the level of the large ball, which then floats up to the upper seat, at the same time releasing the compressed air supply. The pressure closes the check valve on the inlet side, and also keeps the large ball tight against the upper seat, forcing the liquid up the discharge pipe. Part of this liquid fills the branch pipe leading to the upper valve seat.

When the contents of the apparatus have been discharged, the air passes up the discharge pipe, relieving the pressure and allowing the ball to drop again onto the lower valve seat, thus cutting off the compressed air supply. The weight of the small column of liquid in the

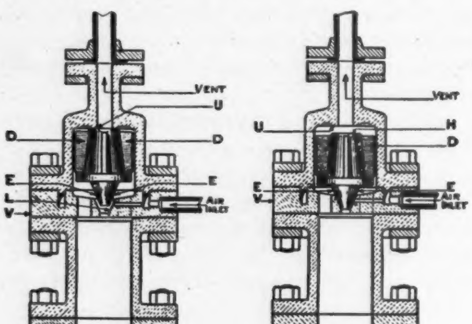


Courtesy, General Ceramics Co.
"Plath" Automatic acid elevator.

branch pipe above the upper valve seat accelerates this movement of the ball. The pressure in the apparatus now having been removed, the acid is again free to enter through the check valve and the operation is repeated indefinitely. The consumption of compressed air is small, as it is merely equivalent to the volume of acid delivered (calculated to the initial pressure) the air supply being completely closed when the apparatus is not discharging. All parts that come in contact with acid are of stoneware. No attendance at all is required.

Details of the Air Device of the Bihn-Jones Elevator

The other illustration shows the Bihn-Jones Automatic Blow Case made by the Schutte & Koerting Company. This operates on almost exactly the same principle as the Plath, ex-



Air device of Bihn-Jones elevator.

cept that a cone is used instead of a ball. It is a most excellent device, efficient, entirely automatic and reliable.

This air device is composed of:

First—A base (V), which contains a seat (L), to which a number of ports for the admission of compressed air lead from an air chamber, which completely surrounds the seat.

Second—A piston disc (D) having a conical seat (E) on its lower surface, which contacts with the seat (L) in the base, thus completing the compressed air valve. There is also a flat circular exhaust valve seat (U) on the upper surface of the disc.

Third—Of a hood which is bolted to the base, thus forming a cover for the apparatus, and a cylinder in which the piston-disc (D) moves. This hood contains an exhaust port, which connects with a vent pipe. Around the exhaust port of hood there is formed a flat circular seat (H), which contacts with the seat (U) on the upper surface of the piston-disc (D), and thus completes the exhaust air valve.

Details of Operation

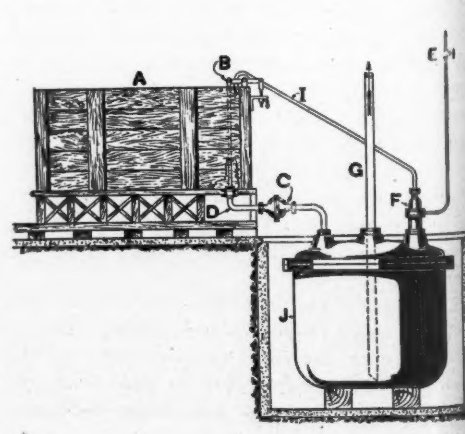
Liquid from a supply tank "A" flows by gravity through a check valve "C" into the blow-case "J" and rises until it reaches the base of the disc "D" of the automatic air device "F," which it raises slightly, thus permitting compressed air to enter. The sudden release of the compressed air forces the disc "D" upward against its upper seat "U," thus closing the exhaust valve to the vent pipe "I." The air thus prevented from escaping exerts its pressure on the top of the lid, closes the check valve "C" and forces the liquid through discharge pipe "G" to its destination. When the level of the liquid reaches the opening of the discharge pipe at the bottom of the blow-case, the compressed air follows the liquid out through the discharge line (completely clearing it of liquid), and escapes momentarily at the end of the discharge line. The expansion of the air, in the blow-case, due to the decreasing load as the liquid is forced out of the discharge line, causes a reduction in pressure in the blow-case sufficient to permit the disc of the air device to drop into its lower seat by its own weight. This simultaneously closes the ports of the compressed air valve and opens the exhaust air valve, thus releasing the exhaust air in the blow-case. The check valve now opens due to the head of the liquid and the blow-case begins to fill, thus repeating the operation.

During the filling of the blow-case the exhaust air or gas which remains after pumping, is displaced by the incoming liquid and escapes through surge holes in the base of the air device, passes through openings at the side of the disc and escapes through the exhaust port and the vent pipe "I."

The Metrolift made by the Walter E. Lummus Company is another interesting device of the same kind, except that it is more usually used for volatile liquids, extracts, solvents, etc., than for acids. It is not only entirely automatic, but it starts and stops itself without attendance, and measures, counts and records the amount of liquid handled.

In the air-jet lift, or air-lift, air is compressed into the lower end of a pipe which extends about as far below the base of the tower as the acid is to be lifted above it. The air mixes with the water inside the air-lift, thus forming a mixture of air and water, the density of which is less than the column of solid water in the other arm. Thus the mixture of air and water is driven upwards. The diagram shows an installation of this kind. In cases where it is undesirable to excavate so far there can be less submergence and more compressed air used.

Discharge pipe velocities, for example with a twenty foot recovery tower, a tank two feet below the tower base, and a submergence of eleven feet below that—or thirteen feet



Courtesy, Schmutte & Koerting Co.
Typical acid elevator installation.

below ground level, range from six to twelve feet per sec. initial and eighteen to 25 feet per sec. final.

A useful formula is the following for the pressure required:

$$V_a = \frac{h}{C \log \frac{H+34}{34}}$$

V_a = *cu ft. free air per min. per gal. water or other liquid.*

h = *head in feet*

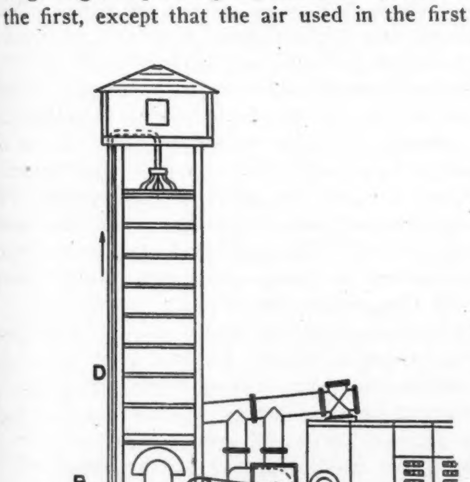
H = *submergence*

C = *a constant, which varies for the lift. This may be taken as 245 for lifts of 10 to 60 feet and 233 for lifts of 61 to 100 feet.*

For hydrochloric (muriatic) or nitric acids this figures out so that one gallon of liquid requires from eight to nine gallons of air under conditions stated above.

To sum up: Air lifts can well be used where there is no special objection to excavation, where excavation is not necessary or where the lift is not too high. Hand-operated *monte-jus* are useful when small volumes of liquid are to be elevated at irregular intervals. Automatic *monte-jus* are advisable where the amount of liquid is large, the lift comparatively great and the flow steady and uninterrupted.

Efficient air-lift systems are now on the market where the liquid is elevated in two stages. They come under the general type of compound lift, and raise the liquid a distance approximately 50 per cent. of the total height at the first stage. It is then released into an enclosed chamber, and at this point the second stage begins operating on the same system as the first, except that the air used in the first is further employed to exert a pressure on the surface of the liquid being elevated in the second stage. There is considerable economy due to the ability to utilize lower pressures throughout the whole operation, and it enables the obtaining of proper submergence where it is not proper to excavate to the required extent.



Courtesy, Schutte & Koerting Co.

Typical air lift system for acid towers.

It should not be assumed that elevation of liquids by compressed air is confined to acids. One of the writers operated, with complete success, a system for handling all the liquids of an alcohol recovery plant. The average daily amount of alcohol handled was 10,000 gallons per 24 hour day. The acidity of the alcohol to be recovered ranged from two to six per cent. Owing to this acidity, the liquor was first neutralized in wooden tanks. These were agitated with compressed air. The precipitate, of dye waste, insoluble in alkaline solution, was filtered through wooden frame presses, by compressed air, using a *monte-jus* for this purpose. The filter press receiving tank was fitted up as a *monte-jus*, and the filtered liquors were blown to storage tanks, below ground level, a distance of about 500 feet. These storage tanks were also fitted up as *monte-jus*, and the contents were blown into the recovery stills direct from time to time as needed.

The pressure gage of the air receiver in the power house averaged 70 pounds. The air pressure required for agitating in the neutralizing tanks was about five pounds, the pressure required for blowing the filtered product to the storage tanks averaged 30 pounds, and that required to send the liquid through the presses was between two and ten pounds, depending on the quantity of precipitate. The air required for blowing the weak alcohol to the stills ranged between 30 and 40 pounds.

Throughout a period of eight months, working 24 hours per day, no delays were experienced in plant operation due to the failure of the system. In the above period, operations were continually being carried out by compressed air from the same system in other divisions of the plant, especially in the press house, where some 30 filter presses were operated by *monte-jus*. This alcohol recovery department could have been even more economically run if there had been time to install more of the refinements of compressed air equipment. The advantages are: (1) Saving in repairs to pumps, piping and fittings. (2) Wages of mechanics. (3) Reduced loss due to empty pipe lines after blowing. (4) Source of power being located in the power house, all important machinery being under direct supervision of the chief engineer.

Another illustration from our own experience is a plant where a large volume, approximately 6,500 gallons per ten hour day, of highly caustic liquor, containing much grit, was required to be pumped from a leaching system to a recovery plant, and back again. Centrifugal pumps had to be abandoned on account of the terrific erosion of the impellers, as well as scoring of the bearings and chemical corrosion. Reciprocating pumps were out of the question for the same reasons. The liquor was elevated from a pit placed below the bottom of five leaching tanks, advantage being taken of a sharp natural declivity to avoid excavation. The foot-piece was placed in a concrete pit about five feet deep, the column being of sewer pipe. The liquid was delivered to a distance of over 500 feet to a receiving tank, from which by means of *monte-jus* it was delivered to the presses at a pressure approximately constant at 4½ pounds.

Eight oil-fired reverberatory furnaces, as well as a water system and several *monte-jus* and filtering devices, were operated from this same system, which was located in the general power house of the plant. At times slight difficulty was experienced with excessive air pressure, due to sudden falling off of the air requirements of other parts of the plant, but this was eventually taken care of in splendid manner by an electric system of control. In its completed form this installation has operated over five years with almost no attention.

Filtering

There is hardly any part of the chemical industry where filter presses and other filtering equipment are not needed. Chemicals, dyes, explosives, ceramic products, sugar, foodstuffs, beverages, petroleum products, paint and varnish materials and hundreds of metallurgical processes require this kind of processing.

Filter presses are fed either by *monte-jus* or centrifugal pumps. Either of the above is preferable to reciprocating pumps, which pack the cake by their pulsation, and injure the press if neglected.

Compressed air is used in filtering for the following reasons: When building up a press cake on the filter press plates, for those precipitates which have a tendency to pass through the filter cloth or wire, the hand controlled *monte-jus* serves perfectly. When the *monte-jus* is filled, and the press is ready, the air valve is opened about a quarter turn, till the gage of the *monte-jus* registers one or two pounds. This air pressure is maintained for some few minutes, depending on the material being filtered, until, in the judgment of the operator, there has been formed on the filter cloth a slight layer of the precipitate. The pressure is then raised another pound or two. This may be repeated until the desired amount of cake is on the cloth to reinforce the filtering medium. The full operating pressure necessary to filter the particular material is then reached. An examination of the filtrate will reveal a clear solution. After the washing of the cake in the press, the air may again be turned on, with a uniform increase in pressure, and a preliminary drying of the cake may be had, facilitating its easy removal and subsequent handling.

The uniform, and gradually increasing pressure on the filter plates obtained by the use of compressed air and the *monte-jus*, as compared with the pulsations and high starting pressure prevailing with pumping equipment, makes the former method of operation preferable for most products. The economies include: (1) High filtration efficiency for solutions containing small quantity of precipitate and colloidal substances. (2) No uneven pressure. (3) No attendance required after building up initial deposit. (4) No moving parts.

(5) Full pipe passage to the press for heavy or slimy precipitates. (6) Even pressure over a long period of time for slow filtering materials, with no consequent increase in cost for attendance. (7) Low first cost.

This method is applicable where crystals formed in mother liquor must be filtered in such a way as not to break down the crystal structure. The free passage to the press preserves the size of the crystals, obviating the crushing and milling they get passing through a pump. Some products which form fine precipitates quickly close the pores of the press and take a long time for filtration. For instance, hydroxide of iron, which is usually filtered in a Kelly press. It sometimes takes 24 hours to filter 500 gallons of this. In such cases the compressed air method has obvious advantages.

Agitating and Mixing

In this line of work, compressed air is extensively used, either as the sole means of accomplishing the work, or as an auxiliary to mechanical agitators. In the petroleum industry compressed air is used for the chemical treatment of the products. This treatment consists in agitating the oil with sulphuric acid, to remove the tarry matter, after which the oil is given another agitation with alkali. These treatments are carried out in what are called "agitators" being vertical steel plate fabricated towers, having a capacity of about 2,400 bbls. for the acid treatment and 1,200 bbls. for the alkali treatment. Both the acid and alkali are delivered to the agitator, as a rule, by compressed air, *monte-jus* being used.

In the chemical treatment of cotton linters, for preparing cellulose for nitration, compressed air is used for agitation. The cotton linters after treatment with caustic soda in a digestor, are then blown with steam to a large tank, having a capacity of about 4,500 gallons. Here the cotton is bleached, and the air is used to give a thorough agitation, in conjunction with a mechanically driven agitator.

Another use for compressed air is in the blowing, or oxidation of many oils. Compressed air has been used for pumping molten alloys, by the air lift system. Compressed nitrogen has been used for the same purpose, handling it just the same as air.

In the manufacture of yeast, compressed air is used for ärating the wort in the fermentation tubs. This promotes the respiration and reproduction processes of the yeast cells.

Asphaltic products are made by oxidizing petroleum residues by means of a current of air under pressure, the liquid being heated.

The flotation process of ore concentration may be considered as akin to agitation. Immense tonnages of copper and other ores are being handled by this method to-day. Many of these ores could not be profitably worked by any other method. This process involves the blowing of air into mixtures of crushed rock and water. The air adheres to the ore in preference to the gangue, thus buoying it up and permitting its recovery.

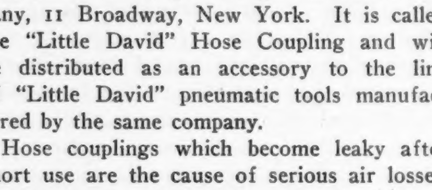
The chemical engineer has to use compressors for many gases in addition to air, such as chlorine, sulphur dioxide, natural gas, etc. There are few classes of manufacturing operations in which engineers should consider the use of compressed air equipment more closely than the great group of industries, which is called "the chemical industries" because they all use chemical processes, and supply the basic necessities of almost all other lines of manufacture.

NEW DESIGN OF HOSE COUPLINGS.

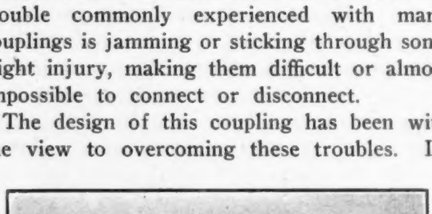
A HOSE coupling with several new and important features has recently been placed on the market by the Ingersoll-Rand Company, 11 Broadway, New York. It is called the "Little David" Hose Coupling and will be distributed as an accessory to the line of "Little David" pneumatic tools manufactured by the same company.

Hose couplings which become leaky after short use are the cause of serious air losses, whether in the small shop or the large plant using hundreds of hose connections. Another trouble commonly experienced with many couplings is jamming or sticking through some slight injury, making them difficult or almost impossible to connect or disconnect.

The design of this coupling has been with the view to overcoming these troubles. Its



Parts of "Little David" hose coupling.



Couplings in locked position.

main features are its sturdiness and simplicity, and an all around ability to stand lots of abuse without affecting its service.

The coupling consists of two parts, male and female. The female end is fitted with V-shaped rubber gasket providing an air tight joint. The gasket is prevented from blowing out should the coupling accidentally be disconnected under pressure, by a protective shoulder inside the coupling. The female end is exceptionally sturdy, there being no exposed parts which might be liable to injury and cause jamming or sticking.

The locking shoulders are heavy with large bearing surfaces. The locking spring is strong and durable, and can be replaced if necessary. The parts are made of a metal not subject to ordinary rusting or corrosion.

The male end has a very liberal bearing in the female end which assures alignment and long wear. Another feature is the absence of any outer sleeve exposed to injury. The air ports are straight and of uniform diameter, offering least restriction to the air.

The coupling may be connected or disconnected by a quarter turn. A groove in the hose end of each part allows using a hose clamp to attach securely to the hose.

"Little David" Hose Couplings are manufactured in one-half-inch and three-fourth-inch sizes, which are interchangeable; that is, a one-half-inch male piece may be used with a three-fourth-inch female end or vice versa. Gaskets are also interchangeable between the different sizes.

FOR THE GREAT "NORTH" RIVER BRIDGE

Things are moving slowly, but they are certainly moving toward the erection of the inevitable and most cruelly needed bridge to cross the Hudson at New York. Incorporation papers have been filed at Albany for the Hudson River Bridge Corporation. It is intended to promote the construction of a bridge from the design which has been made by Gustav Lindenthal, engineer for the Hell Gate bridge. The entire plan, which includes terminals in Manhattan and large railroad yards in New Jersey, it is estimated will cost $200,000,000. The proposed bridge would accommodate both railroad and highway traffic; it would have fourteen tracks and a capacity equal to that of twenty tunnels, while its estimated cost is less than one-half as much as the cost of that number of tunnels. The imperative ventilation problem is also avoided.

CARBON DIOXIDE AS A FERTILIZER

Some very remarkable experiments have recently been made in Germany, with a view to ascertaining plant growth, by furnishing plants with artificial supplies of carbon-dioxide or "carbonic acid gas" in addition to what they ordinarily obtain from the atmosphere. The idea is to irrigate fields with carbon-dioxide obtained from the exhaust gases of motors and furnaces. The first tests were made in a hot-house, the gases being diluted until they contained one-half of one per cent of carbon-dioxide. This additional carbon in the atmosphere produced unexpected results, the yield of cucumbers being twice as great as in the normal plants and that of tomatoes nearly three times as great. Equally good results were obtained in the case of plants grown outside. The carbon-dioxide was furnished here by means of perforated pipes, which traversed the field. It is estimated that an industrial furnace furnishing 1,000 tons of iron per day, yields a sufficient amount of exhaust gases to fertilize 4,000 tons of potatoes.

Some years ago a photograph of the moon by ultra-violet light showed a peculiar dark spot near the crater Aristarchus, and Prof. R. W. Wood found that a view taken through a yellow coloured screen did not have this spot, though it was faintly visible through a violet screen. In experiments with many terrestrial volcanic rocks and the same colour screens, only rocks containing a thin film of sulphur gave the same effects. Sulphur being thus identified, it is now asked whether some method of recognizing other moon minerals cannot be developed.

SAND BLASTING IN FINE MACHINE WORK

OXIDE SCALE produced on the surface of castings or forgings, according to a recent article in *Machinery,* is considerably harder than the body of the metal; and where parts covered with such a scale have to be machined, the cutting tools are likely to become dull after only a short period of service. To overcome this difficulty it is quite a general practice to resort to the use of a sand-blasting machine for removing the scale; but it is probable that few mechanics have heard of using the same method of preparing work in which the insides of small openings have to be ground. This method has been adopted in the National Acme Co.'s plant in Cleveland, Ohio, for preparing raceways for ball and roller bearings that are to have the bore ground on internal grinding machines. After being machined, these pieces are subjected to a process of heat-treatment to give the desired physical properties to the steel, and the sand-blasting operation is next performed to remove the oxide scale produced on the work while in the furnace.

At the time when a decision was reached to sand-blast these pieces before grinding, the primary object was to effect an increase in the rate of production, and subsequent experience has shown that this increase amounts to fully 50 per cent., as compared with the time required for grinding raceways that have not been sand-blasted. Small grinding wheels used for precision internal grinding operations are more delicate and more likely to become "glazed" than larger sized wheels. If an attempt is made to grind work that is covered with a hard oxide scale, it is found that the grinding wheel requires dressing with a diamond at frequent intervals in order to remove the glazed surface which is no longer capable of cutting efficiently; and for that reason the removal of the scale from the work that is to be ground with such wheels becomes a matter of unusual importance.

It has already been stated that the rate of production has been increased 50 per cent. by a preliminary sand-blasting operation. This saving is due to the fact that it is unnecessary to stop work as often in order to dress the wheel, and as a result the grinding machine is able to operate for longer periods without interruption. Another important saving resulting from the sand-blasting operation is that the working life of each wheel, that is, the amount of service obtained before the wheel is worn out, is substantially increased. Average results show that at least double the amount of service is obtained from each wheel where it starts work on the clean metal surface without being required to first remove a hard outer layer of iron oxide scale.

It is announced that the Panama Canal traffic of the calendar year of 1920 set new high records, 2,814 commercial vessels of 10,378,000 net tons carrying 11,236,000 tons of cargo passing through the canal. This exceeded the traffic of the fiscal year of 1920 by approximately twenty per cent. and the calendar year of 1919 by about 50 per cent.

PORTABLE PNEUMATIC SHIP REPAIR EQUIPMENT

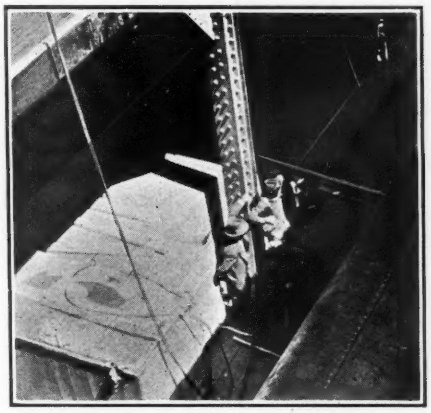
By C. W. GEIGER

THE ACCOMPANYING photo shows the special equipment of the Moore Shipbuilding Company of Oakland, California, used in making repairs on vessels on the Pacific. The equipment is used on the San Francisco Bay, and is ready on short notice to be taken to any port on the Pacific.

The equipment consists of a compressor, and an air tank three feet in diameter and eight feet in height wherein an air pressure of 95 lbs. is maintained.

A flexible 2-in. pipe line extends from the air tank to the manifolds, each manifold being provided with fifteen connections for hose.

The equipment is delivered to any point on San Francisco bay by a barge, in tow of a tug, and lifted aboard the steamer by the tackle of the ship. Sufficient pipe is carried to connect the compressor with the steam from the ship's boilers. One man remains in charge of the compressor at all times. The compressor is mounted on heavy skids, which are held firmly by any weight that may be available.



Operating in the hold of West Conob.

This photo shows repairs being made on the Shipping Board vessel *West Conob,* operated by the Pacific Mail Steamship Co. on the first "round-the-world" service inaugurated by any American steamship company.

The principal work being done on the *West Conob,* was the putting in of a new thrust seating and entirely cutting out the old one. This required the fabricating of the seating using some steel plate over thirteen feet in length and riveting same to tank tops, and engine seatings and bulkheads. This required the lifting of the thrust shaft and thrust block weighing about fifteen tons.

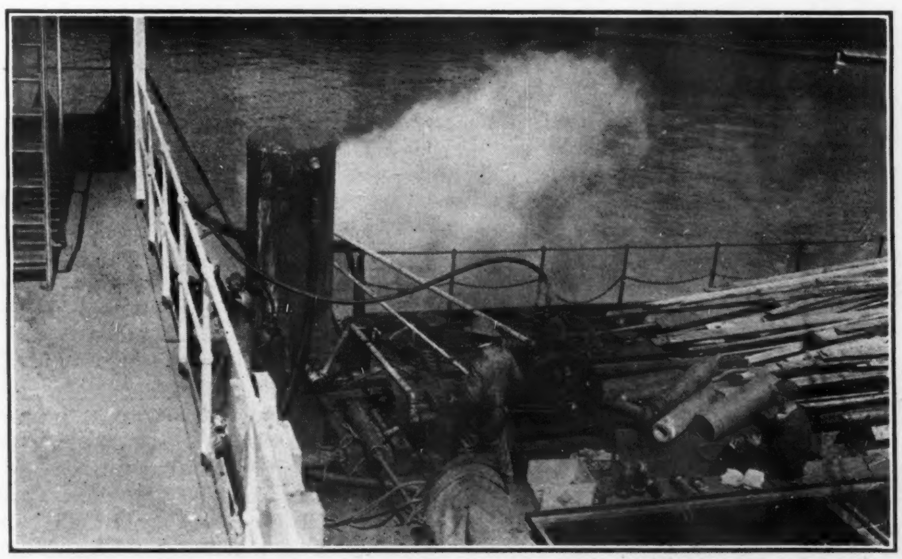
A special picked crew operates this equipment. Air drills, and pneumatic hammers are used principally with the equipment. The crew consists of about 30 men.

TO STOP STORAGE EGGS FROM BLOWING-UP

We can't all have fresh eggs every day in the year and a plenty of them, and cold storage does much to help us out. Storage eggs are much better than none for many purposes. They are not at their best when we try to boil them, and they have a detestable habit, many of them, of blowing up and scattering their insides before the boiling is completed.

If the storage is for a long period and the conditions are not of the best the contents shrink more or less, leaving an empty space inside the big end. The space is not really empty but is filled with air or gas. The heat of the boiling develops a considerable pressure in this air and that is what causes the explosion. Before you put an egg in the water to boil, push a pin into the middle of the big end and it will not blow up. If the egg is covered by the water you can see air bubble out as the heat increases. None of the egg escapes.

In a recent flight Mail Pilot Moore completed a round trip by a aeroplane between Cheyenne and Salt Lake City, between dawn and darkness. Pilot Moore left the Cheyenne field at 5.42 a. m., delivered 400 lb. of mail in Salt Lake City and was back in Cheyenne at 4.44 p. m. He had flown 800 miles, crossed the Rockies twice and made two stops. At times he attained an altitude of 13,000 feet.



Showing special equipment of Moore Shipbuilding Co. making repair on West Conob.

Compressed Air Magazine

—Founded 1896—

Devoted to the mechanical arts in general, especially to all useful applications of compressed air and to everything pneumatic.

Business and Editorial Offices:
Bowling Green Building, No. 11, Broadway, New York City, U. S. A.
Telephone: Bowling Green, 8430

Publication Office: Somerville, New Jersey

Chicago Office:
Peoples Gas Building,
Michigan Avenue and Adams Street
Sears & Irving,
General Western Advertising Representatives.

Business Office for the British Isles:
Advertisements and Subscriptions.
J. F. Atkinson, Representative.
No. 31, Essex Street, Strand, London, W. C. 2,
Telephone, Gerrard, 6659.

Cable Address:
"Compaire," New York. Western Union Code.

TERMS OF SUBSCRIPTION

$3 a year, U. S. A., American possessions and Mexico; all other countries, $3.50 a year, postage prepaid. Single copies, 35 cents. Back issues more than six months old, 75 cents each. Annual subscription throughout the British Empire, £1; single copies, two shillings.

COMPRESSED AIR MAGAZINE CO.
PUBLISHERS.

WILLIAM LAWRENCE SAUNDERS
President

G. W. MORRISON
Treasurer and General Manager

EUGENE P. MCCRORKEN
Editor

FRANK RICHARDS
Associate Editor

ROBERT G. SKERRETT
Contributing Engineering Editor

MARY V. MCGOWAN
Editorial Secretary

ARTHUR D. MCAGHON
Secretary

FOREIGN CORRESPONDENTS

Paris
BEN K. RALEIGH
No. 33, Rue Reaumur

London
ROLAND H. BRIGGS
No. 165, Queen Victoria St., E. C. 4

Berlin
CHARLES A. BRATTER
No. 23, Kochstr, SW., 68

Vienna
HERMANN BRINKMANN
No. 3, Tuchlauben, I

Madrid
LUIS BALDASANO Y LOPEZ
No. 7, Jorge Juan

Correspondence invited from engineers, chemists, experimenters, inventors, contractors and all others interested in the applications, practice and development of compressed air. Correspondents and contributors will please submit questions, or matter for publication, accompanied by self-addressed stamped envelope; they also will please preserve copies of drawings or manuscripts as we cannot guarantee to return unavailable contributions in the event of rejection, though our practice is to exercise diligence in doing so.

EDITORIALS

THE UNIVERSE IN VACUO, IN DARKNESS AND IN SILENCE

THE ONE THING that is bigger than anything, bigger than all the things of which we have any knowledge, knowledge complete and direct or knowledge circumstantial and inferential, the one thing bigger than all things is no-thing. And this for the simple reason that it contains and encloses all things.

Some thoughts concerning nothing, from the above view-point, have been provoked by the statements recently current in the secular press about the distance and dimensions of the star which twinkle twinkles in the constellation Orion. It seems to be determined with some show of authority, and with some approximate approximation to the fact—with the square root of the approximate, let us say—that the distance of Betelgeuse from us is 150 light-years, although another fellow, presumably equally competent and reliable, says the distance may be 300 light-years. We can readily and as easily accept the latter figures as the former, and this we do hereby.

Then with the speed of light, 186,000 miles per second, for a starter, we have a neat little "sum" challenging our mentality to work out. It is like this: 186,000x60x60x24x365x300=1,759,708,800,000,000 miles. The figures are big enough to strain our imagination to the limit, though it is quite certain that there are other stars much more distant than this! The talk now is even of millions of light-years to the most distant of the masses whirling in space! But even in the presence of such figures as these we are still compelled to believe that there must be, and that there is, an outside or a circumscribing limit to the material universe somewhere.

But what then? We may picture in our minds an imaginary, invisible and entirely nonexistent spherical shell, with, if you please, ourselves conveniently assumed to be in the centre of it, this imaginary shell indicating the limits within which the great stellar masses may revolve to the utmost reach of their orbits, the space so imaginarily enclosed not only leaving ample space for all the solid or more or less visible and tangible bodies to swing to their uttermost, but also for the utmost reach of the accompanying ethers and the more subtle and attenuated agencies of inter-communication; and this only brings us in view of the greatest puzzle of all.

Our assumption of this circumscribing and all-containing sphere for the entire material universe necessarily includes the hypothesis that there must exist a conceivable and indeed an actual limit to existing things. Outside of this assumed limit is the place where nothing begins, and it is at once impossible to imagine that there is or can be any limit or end or outside to this vast nothing which surrounds everything.

Whether the mass or sum of the materials constituting the universe is all completed, or whether creation still goes on, so that the outer limits of things are being extended from time to time, it does not concern us here to inquire. There is still always and everlastingly room to spare outside, and *nothing* can *not* be crowded.

It will not do for any terrestrial grammarian to challenge the preceding sentence. There are other possible shocks awaiting him. In our all-enclosing nothing, it is to be remembered, all material things and all their accompaniments are conspicuously absent. Nothing contains absolutely nothing, and not for lack of space.

There is no atmosphere and consequently there is an absolute and all-pervading vacuum, a vacuum more perfect than ever produced by human artifice. There is no heat, no production or radiation of heat, and consequently absolute zero of temperature. There is no means of producing light, nothing radiating light, no luminiferous ether for its transmission, and, consequently the "outer darkness" of which we read. So also there can be no electricity nor magnetism, no gravitation and no bodies which gravity could get hold of. There could be no weight and no vertical or horizontal.

If any thing could be located any where in this no-thing it would remain there inert and motionless, but if given a shove in any direction it would continue to move in a straight line and at constant speed, and would in time arrive nowhere! Indeed, and this is our stopping place, how could there be any time since there could be no succession of events, nothing preceding or following anything?—*R.*

THE DANUBE TO SUPPLY POWER TO AUSTRIA

THE DREAMY waltz music of *The Blue Danube* supposedly symbolizes the slow, poetic movement of that river; the very soul of the waltz measures. But different times, different manners. The Danube is soon to be a jazz stream, jazz in this sense signifying speed and energy. The Danube is to be turned into "white coal," the attractive name which has been given to water power.

This is as it should be; all Central Europe is prostrate. Water power, with the magic assistance of compressed air, will serve to rehabilitate it without the use of irreplaceable natural resources such as coal and oil fuel. Wasteful war has compelled the Receivership of Peace to put to labor all that mighty force contained in the scientific manipulation of the river preëminent in musical romance.

Colonel A. B. KRATZ, an associate of Mr. WALKER D. HINES on the Commission of Roads and Waterways of Western and Central Europe, who recently visited Paris, gave some details of the scheme to our editorial correspondent there. Colonel KRATZ was formerly in command of the Eighth Army Engineer Corps of the American Expeditionary Force. The Commission of which he is a member is concentrating its investigations on the navigation problems presented by the blue Danube and its possibilities as a source of water-power.

There is, in the opinion of Colonel KRATZ,

who is an engineer of vision, enough power going to waste at the Iron Gates of the Danube to light all of Central Europe, to operate great manufacturing plants and to run trolley lines and other public utilities. There is a clear field there, it is his belief, waiting for those interested in water-power construction. Electricity could be supplied through several countries by the use of this vast, wasted force.

From other sources we learn that Americans are advising the Austrian Government as to the steps necessary to realize this programme and that the first steps will be taken shortly, which will materially assist in releasing man from his serfdom to King Coal. The Austrian Government has practically decided upon a 1,000,000 horse-power plant above Vienna, on the Danube. Ten other hydro-electric stations are to be built in the mountains, so that all Austria will some day have an abundance of cheap current for heating, lighting and driving machinery.

We shall not lose the slow, dreamy music called *The Blue Danube*. But the river of yesteryear, which inspired it, is to give out a clearer, more vital tune, a tune of industry and comfort and happiness for millions of people to whom, at last, are to come, through the aid of the mechanical arts, surcease from grind and toil—toil of the wrong sort. The hum of industry, the chatter of happy, free, workmen is also sweet music and that is what water-power, with the assistance of compressed air, now promises the countries of Central Europe.

WAR AND SOVIET SECRETS MR. HOOVER'S GIFT

HERBERT HOOVER, president of the American Institute of Mining and Metallurgical Engineers, has presented to the trustees of his *alma mater*, Stanford University, Palo Alto, California, what is regarded as the greatest collection of secret Russain Bolshevist documents and secret documents of various other European governments, that there is in existence. These records already consist of 375,000 volumes, manuscripts and important official pamphlets, and more are coming from collectors in Europe, according to the New York *Times*.

In the lot already deposited in the university's library in California are more than six thousand volumes of court documents covering the complete official and secret proceedings of the Kaiser's war preparations and his wartime conduct of the German Empire, every record, in fact, except those of the Grand Military Headquarters itself.

The only records of the Bolshevists' initial meetings and organization plans are in the collection. During a troubled period a doorkeeper sold these first Bolshevist records to an agent of Mr. Hoover for $200 cash. Another large factor in the collection consists of volumes discovered in Finland. Allied permission was given to Professor Adams of Stanford, a member of the Food Relief Commission, to take possession.

From the first of his association with the interallied relief of European peoples Mr. Hoover realized the value that original documents or attested copies of them would be to future historians, and through his 1,000 agents in Europe appeals were made in every country for such material.

AMERICA'S DEVELOPMENT OF ITS GLASS INDUSTRY

GLASS MAKING in the United States is one of the oldest national industries. It had its inception among the English colonists of Virginia more than 300 years ago. Since then, as America has grown great and demanded the comforts and conveniences of a highly developed civilization, the manufacture of glass has mounted to tremendous proportions. In 1914, capital invested was approximately $154,000,000, and annual output was about $123,000,000.

COMPRESSED AIR MAGAZINE recently commissioned Mr. ROBERT G. SKERRETT to make a survey of various departments of the glass industry and to prepare a series of articles on the status of the art in America. The first of his articles appears in this issue and concerns itself with the manufacture of bottles, tumblers, and kindred ware.

In the course of 300 years American glass makers have undeniably made marked advances; they employ methods probably undreamed of in the days of pioneer settlers when the need of bottles inspired the use of beach sand and of potash obtained from wood ashes to provide the basic glass. Even so, investigation reveals the industry to be somewhat unbalanced in the sense of technical development, reflecting in this sense a condition that has been all too widely prevalent in other domestic lines of enterprise. Not only that, but until latterly the glass maker, taking him generally, was somewhat itinerant—shifting his base of operations in the pursuit of cheaper fuel.

In the eighteenth century, most of the American factories were located along the Atlantic seaboard, principally in southern New Jersey. There the manufacturer found plenty of standing timber to furnish wood for furnace fuel, lumber for boxes, and ashes from which he could get an indispensable alkali. Sand was in easy reach; oyster shells when calcined supplied him with lime; clay deposits yielded furnace bricks and refractory pots.

But the time came when the forests in the vicinity were stripped. About 1796, coal in Pennsylvania made its claim as a superior fuel, and the glass industry started its migration westward and established itself largely in the Pittsburgh district. Low-priced fuel latterly has determined the choice of a glass-plant site, the development of oil fields and the discovery of natural gas being important factors. The exploitation of natural gas—for a time the cheapest and best of fuels for glass making—inspired the creation of hundreds of "mushroom" furnaces, and these, as well as a goodly number of older concerns, were forced to the wall when the natural gas supply began to fail and the price rose.

To-day, the fuel problem is still more acute. Petroleum, admirable as it is in various ways, costs too much to be used commonly. There is a rapidly growing tendency towards the erection of producer-gas installations which, when close to coal mines, can be made to provide the desired fuel at less than the current charge for natural gas. In this trend is evidence of the continued effort of the glass industry to effect both economies and produce betterments through recourse to mechanical agencies, stabilizing at the same time the fuel problem which, next to labor, involves the largest single expense entering into the manufacture of glass.

Inventive cunning has been strikingly helpful in transforming the whole art of glass making; and we are glad to note that compressed air figures conspicuously in the improvements which have been brought about within the last 30 years. Labor-saving machinery of different kinds, functioning often in a marvelous manner, has been devised, and the future of the industry unquestionably rests in large part upon the readiness of manufacturers to avail themselves of these aids. Indeed, it is probably no exaggeration to say that the evolution of such apparatus has served not only to stabilize the industry but to make for more wholesome surroundings for the 80,000 operatives engaged in it.

What might be called the engineering revolution of the industry had its inception along about the middle "nineties," when the so-called automatic machine for the making of wide-mouth bottles and jars was given to the world. While not truly automatic, that machine was able, with the assistance of a few attendants, to produce a much larger volume of the desired commodities in a given interval, and the ware was, besides, more uniform than that turned out by hand. At present machines are employed that are actually automatic and capable of amazing performances. The largest of them can manufacture in the course of 24 hours tens of thousands of bottles and vials.

Notwithstanding such highly impressive mechanical advancements much remains to be done in the direction of chemical research and experiment, Mr. SKERRETT tells us. Only three years ago, Government investigators reported that the average manufacturer's chemical knowledge of the materials entering into the making of glass was very vague and indefinite. They related that few American producers had carried on scientific research, and declared that they had found a woeful lack of chemical knowledge. As they expressed it:

"It appears as though all the energy of the glass makers in recent years has gone into the perfection of machinery as the one means of lowering cost. The batch could take care of itself. That the most perfect machine is absolutely useless with bad glass does not appear to have been taken into consideration."

It is gratifying that this condition has been altered materially for the better since the Great War threw us upon our own resources and shut off from us foreign supplies of certain superior kinds of glass, as well as from chemical refractory materials of alien sources. Now,

thanks to the work done in laboratory and testing shop American makers have become proficient and self-sufficient. American glass of almost every variety is today the equal of that produced in Europe and some of it is distinctly superior. The future of the industry bristles with potentialities as glass will inevitably be put to wider uses and to novel adaptations not yet known to the prospective consumer.

EDUCATING THE PUBLIC ON COMPRESSED AIR

A NEW contribution to the subject of compressed air and the manifold applications of this modern and fast-growing power medium appeared recently in a popular periodical of very wide circulation in America, The *Saturday Evening Post,* from the pen of that busy investigator of things constituting "Everybody's Business," Mr. Floyd W. Parsons, one time editor of the *Coal Age.* Such an article is a commentary on the value of the kind of educational work that can be accomplished by a journal of such tremendous circulation and wide influence. As a result of the article in question millions of folk were introduced to a subject on which they probably had only hazy ideas, albeit it is a subject of everyday importance in their lives and actually is "Everybody's Business," as Mr. Parsons's department is aptly named.

The technical journal, and ours happens to be the only one in existence covering the field described in Mr. Parsons's article, has a comparatively small range of appeal on educational topics, compared with the popular weekly or monthly of large circulation. As a matter of fact, of course, the readers of a technical journal are those who are peculiarly interested in the subjects it covers, and they are interested more in new developments than in generalities. Mr. Parsons in his article entitled, *The Industrial Uses of Air,* covers both of the latter in a way to make his subject intelligible to the lay mind. He reviews many matters that have appeared in great detail in our columns over a period of years, but he gives the human and popular twist to them to make them readable to others than engineers, and in this lies the secret of his success as a technical man writing for untechnical readers.

He sums up by saying that "air is the freest and most abundant of all Nature's elements, and one day it will probably be the most widely used force in the world's industrial life." There are few technical men conversant with the subject and following today the latest developments in air practice who would care to gainsay this broad assertion; there are in truth too many possibilities ahead that are indicated by present accomplishments. At the same time the greatest authorities hesitate to make predictions.

The writer showed at the outset that of all things that are free and plentiful, none is more so than air. That is why it contains such potentialities, of course, and why we may look forward confidently to greater realization of them. Although air has surrounded man since the beginning of the human race, and has been the chief essential of life, the writer shows that centuries passed before air was utilized to any considerable extent in serving the purposes of civilized nations. "For more than a thousand years the world's most advanced people failed to realize that air possesses compressibility which can be converted into a useful force."

We go on to quote some of the musings of Mr. Parsons:

"One morning not long ago, after a heavy dew had made the dampened webs of spiders glisten on surrounding trees and bushes, I became interested in the wonderful display of constructive ability shown by these marvelous insects. One industrious spider had spread his web a distance of twenty feet, from a low limb on a big maple tree to the top of a large evergreen bush. The slope of the main line of the web from the tree to the bush was almost level. It was evident the spider had selected his basis of operations at the end of the limb with care and foresight. Seated there he had manufactured his main thread and cast it forth on the breeze that was blowing, slowly adding to the length of the thread until one end of it had reached a top branch of the evergreen six yards or more away. With his principal cable thus temporarily strung, the insect had carefully traveled along it, fastened the end and proceeded to build in his wonderful reinforcements, which would have been a credit to any educated architect.

"The thing that made the spider's feat possible was the air. He had utilized its weight and movement with a sureness of instinct that is puzzling. The whole incident originated a line of thought that made me wonder what are the future possibilities of air control by man. Are we deriving maximum benefits from our present practices with air machines? Is the art of air compression an industry that is fully developed? How and where are we putting to practical use the inherent powers of that vast mixture of gases which envelops the earth?"

The author answers some of his own questions by proceeding to detail many of the most important uses of compressed air today. One novel use that he discussed, among the hundreds of ways that compressed air is now serving man to reduce the cost of life's necessities, was the following:

"Down in our cotton-growing states air is the all-important element in the newly developed vacuum cotton-picking machines, which need only six operators and do the work formerly accomplished by thirty-six pickers. Each worker operates two nozzles, which are fastened to a line of hose leading to a storage tank to which is attached a vacuum pump. The operator applies the nozzle to a cotton boll and the cotton is immediately sucked into the storage tank. When the tank is full a cloth sack is placed over a door in the end of the tank, and by means of air pressure supplied by the pump the cotton is blown into the sack. Hand pickers average about a hundred pounds of cotton a day, while with vacuum-machine picking in various fields last year the pickers averaged six hundred pounds a day. In some districts the planters were compelled to pay hand pickers five cents a pound. The saving through the use of air is self-evident."

For our own readers it would be needless to comment further on popular treatises of this sort except to note that other great journals of widespread circulation, such as *The Literary Digest,* are following with close attention the developments in the compressed air field since it is one so fertile in possibilities of helpfulness to mankind. *F. J. T.*

TRADE-MARKED PRODUCTS SAFEST TO BUY

A LEADING American advertising concern, the Federal Advertising Agency, Inc., of New York, conducted not long ago a campaign "to make people buy *safely.*" It concerned the matter of trade-marked products, that is, products so good that the makers of them are proud to have their imprint upon them and to sell them strictly upon their merits. The advertising agency asked no recognition of its own efforts in the matter, but merely requested business houses of unquestioned standing and respectability to coöperate in the campaign. "A Message to Business America" on the subject was reproduced and published in 25 newspapers, and fourteen trade papers used the material in condensed size or in editorial form. The agency was called upon for more than 50,000 reprints, and chambers of commerce, boards of trade, mercantile associations, advertising and Rotary Clubs gave it wide distribution. This all showed the interest in the subject, which is one of great importance in the selling of honest products today.

Other materials along the same line are now being published with the thought of stabilizing business; homely little essays in the form of attractive, unsigned advertisements are being issued. One we note is entitled, *A Lesson in Buying from Tom Sawyer.*

Tom Sawyer was much disappointed when he first saw the famous Senator Benton, because he had expected a man at least 25 feet high. Tom felt cheated.

Advertised trade-marked goods, like the Senator, have reputations to uphold and expectations to fulfill. For them to be merely *good* is not enough—they must be even a little *better* than the public expects; they must be *"twenty-five feet high."*

To attain a reputation, a product must be good to start with; to maintain it, the manufacturer must constantly uphold or improve his standards of quality, service, and value at pain of instant public disfavor. And the trade-mark name which identifies his goods symbolizes his pledge to do these things.

Buy wisely—it's just as easy! For safety and economy today, buy trade-marked goods of known value.

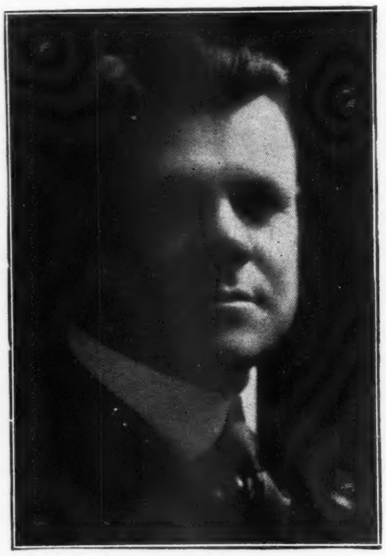
It would be superfluous to add anything to this sage advice.

N. W. Garrett, formerly connected with B. Nicoll & Co. has joined the force of the Irwin Valley Gas Coal Co. of Philadelphia.

RAPID RISE OF DURHAM IN THE MECHANICAL FIELD

Youth will be served, especially when it is equipped with energy, intelligence, good judgment and adequate training. C. B. Durham was still a young man when he began "delivering the goods" in the industrial world. Formerly in the compressed air machinery business, he acquired a liking for the automotive line and in 1909 joined the forces of the Buick Motor Company, of Flint, Mich., as an assistant factory superintendent. In eleven years he forged ahead until he became assistant general manager in charge of works under Harry H. Bassett, president and general manager of the Buick organization.

After only a year at Flint Mr. Durham be-

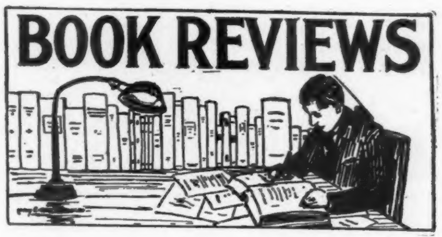


C. B. Durham.

came a full-fledged superintendent of the company's plant No. 1. Two years later he became manager of the unit and four years after tackling the latter job he was made general master mechanic, an important post in such a company as the Buick. In 1918 he was made general superintendent, in 1919 he became works manager, and last year they placed him in his present post as assistant general manager.

We hear it was in 1885, when he waxing thirteen years of age, that "Cady" Durham decided mechanics was his *forte* and procured himself a job with the Silsbee Steam Fire Engine Company at Seneca Falls, N. Y. He has been in machine shops ever since and they still maintain their fascination for him. Part of his wide experience was gained in one of the factories of the Ingersoll-Rand Co., the plant at Painted Post, N. Y.

It may not be generally known that France is the richest country in iron ore in Europe, and that the United States is the only country in a position to challenge her for the leading position of the world. With the restoration of Alsace-Lorraine, it is estimated that the French output will be 45,000,000 tons of iron ore a year, of which 17,000,000 tons will be exportable.



A METALLOGRAPHIC STUDY ON TUNGSTEN STEELS, by AXEL HULTGREN, Metallurgical Engineer, SKF Research Laboratory, Philadelphia. Size, 133 pages, 6x9. First edition, with five full-page diagrams and 76 photomicrographs. Price, $3 net. New York: Messrs. John Wiley & Sons, Inc. London: Messrs. Chapman & Hall, Limited.

AT THE OUTSET it is worthy of note that the laws and phenomena involved in the transformations of tungsten steel have always been difficult for the practical steel man to grasp, as the investigators of the subject expressed views that appeared conflicting and too general to be of much practical use. Mr. Hultgren's new treatise will, or should, prove of great aid to those concerned with this subject, since it presents the constitution and transformations of tungsten steel in a perfectly clear and positive manner, and incidentally throws much light on other alloy steels and carbon steels. The book was written originally in Swedish in 1918. The present volume is a translation and includes an appendix containing a critical review of recent investigations of tungsten steels.

The metallographic investigations, which form the main part of the Hultgren treatise, were undertaken originally at the Institute of Technology of Charlottenburg, Germany, in 1913 and 1914. They were further developed and completed between 1914 and 1918 at the Royal Institute for Testing Materials at Stockholm and in the laboratory of the SKF Ball Bearing Co. of Gothenburg, Sweden. Aside from tungsten steel, the book may also be of value for the study of other alloy steels and carbon steels. There will no doubt be a demand for the book among the steel men of the United States, the greatest steel producing country of the world.

MACHINE SHOP TOOLS AND METHODS, by W. S. LEONARD, formerly instructor in machine shop practice and in practical machine design, Michigan Agricultural College. Seventh edition, revised, with 700 illustrations. Price, $3.50. New York: Messrs. John Wiley & Sons, Inc. London: Messrs. Chapman & Hall, Limited.

LIKE OURSELVES, many of our readers may not previously have encountered the seventh edition of Mr. Leonard's well known book, which has now been on the market for probably a year and a half. The changes made in this edition consist principally of a description in Chapter XXVI of the advantages of the "parallel-depth system" of bevel gears and in instruction for milling the teeth according to this system.

The volume is a valuable textbook for the younger shop man and to a considerable extent it will be found profitable reading, no doubt, for more experienced machinists. At the same time, the book is designed principally for students who know nothing of machine shop practice, and therefore much of the text is of elementary character.

POPULAR OIL GEOLOGY, by VICTOR ZIEGLER, consulting geologist, formerly Professor of Geology and Mineralogy of the Colorado School of Mines. Second edition, illustrated with charts, tables and graphs. Price, $3 net. New York: Messrs. John Wiley & Sons, Inc. London: Messrs. Chapman & Hall, Limited.

THE SECOND edition of the handy little Ziegler book, issued after a lapse of two years, speaks well for the success of the first edition. The book is undoubtedly of actual and practical value to the oil prospector, and for the man without technical or scientific knowledge in this branch of geology it presents the basic principles of oil geology in simple language. It offers aid to the layman who may be interested in the subject from the practical standpoint, or for the sake of making investments, or because of a desire to add to his general knowledge.

It is to be noted that changes in the second edition include the rewriting of the chapter on oil shales, the migration of oil and gas, and the anticlinal theory. New material has been added, also, along the more theoretical lines of geology. The chief principles to be observed in the examination of prospective oil land have received special emphasis from Mr. Ziegler, in the hope that the difficult character and nature of the work of the oil geologist may be properly appreciated.

Publication Notes

The Bureau of Mines of the U. S. Department of the Interior has issued a very excellent and a very valuable treatise entitled, *Quality of Gasoline Marketed in the United States*, by H. H. Hill and E. W. Dean. The preface to this first edition, which is obtainable for 30 cents from the Superintendent of Documents, Government Printing Office, Washington, has been written by J. O. Lewis, formerly Chief Petroleum Technologist, of the Bureau of Mines. Every gasoline man will wish to have a copy of it.

Sinclair's Magazine, of No. 55 Liberty Street, New York, published recently an article reviewing the American airplane industry, and its present status and its apparent chance for growth. In the industrial family the airplane is still a baby, G. B. Winship, the editor, points out, and should not be expected to stand shoulder to shoulder with its older brothers, but it comes of sterling forbears and has already demonstrated sufficient intrinsic worth to merit the careful notice of all who are interested in the basic developments affecting the human race. The article, which is beautifully illustrated, shows that twenty American corporations are actually engaged in the making of airplanes and that at least fifteen are manufacturing airplane motors.

The house journal of the Submarine Boat Corporation, *Speed-Up*, has changed its typographical dress, and is now printed on handsome coated paper. It published a very creditable National Marine Number on the occasion of the annual Marine Exposition at New York in January, in which appeared an article entitled, *The Service and Profit of Newark Bay*, by P. H. W. Ross, president of the Na-

tional Marine League of America. This article presents graphically the story of the advantages of the Port Newark terminal, which the well-informed writer predicts, "will make Newark's fortune."

The Hanna Engineering Works of Chicago has issued a new catalogue, No. 4, illustrating and describing Hanna pneumatic riveters. Special attention of those interested is directed to the photographs it contains showing applications of Hanna riveters to boiler, tank, structural, bridge, car, automotive and steel shipbuilding work; also to interesting tables giving pressures required to drive various sizes of rivets. The catalogue gives a clear and readable explanation of the "Hanna motion," a feature peculiar to the Hanna type pneumatic riveters. In this mechanism are combined in simple form, toggles, levers and guide links to give the "ideal die movement." During the first, or toggling action, the pressure is built up and merges into a lever action, which gives a pre-determined tonnage on the die during that portion of its travel when the head is being formed, the plates are being drawn together and the die is following up the shrink of the rivet until it takes its set.

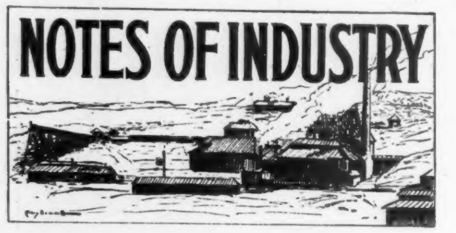
An attractive booklet was recently issued by the B. F. Goodrich Co. of Akron, Ohio, on the occasion of the company's fiftieth anniversary. A half century ago Dr. Benjamin Franklin Goodrich built a small two-story factory in Akron on the banks of the Ohio Canal. They called him a "visionary" at the time, and he was; that is, he had vision! The Goodrich organization today is a worthy monument to its founder, whose creed was, "Let us make goods destined for service." The company has good cause for the celebration of its accomplishments.

We desire to acknowledge receipt of the *Proceedings of the Engineers' Society of Western Pennsylvania,* for 1920. The Proceedings contain two leading papers, one devoted to *Modern Concrete Road Construction, Machinery and Methods,* by George A. Sherron, the other on *Small Steam Turbines,* by W. J. A. London.

The American Society of Mechanical Engineers has issued a brochure listing all of the important publications of the society, including books and discussions, arranged according to subjects.

Mr. Robert C. Weller has been appointed General Sales Manager of The Lakewood Engineering Company with headquarters at Cleveland. Mr. Carlton R. Dodge has been appointed Western Sales Manager with headquarters in Chicago.

The fastest paper making machine in the world made a record recently of 1,000 feet of paper per minute. It is claimed that the principles involved in this machine will entirely change the present method of paper manufacture.



"The Restoration of the World's Commerce" will be the main topic considered at the first annual meeting of the International Chamber of Commerce in London during the week beginning June 27. A large American attendance is expected. There will be discussion of international economic problems in the fields of finance, ocean and land transportation, communication, production and distribution, and restoration of the devastated areas. The International Chamber was organized in 1920 at Paris by representatives from Belgium, France, Great Britain, Italy and the United States. The American Section is organized with offices at the headquarters of the Chamber of Commerce of the United States in Washington.

Reports state that a campaign for the reduction of leakage in the Wichita and Kansas Natural Gas Companies' main has resulted in the saving of millions of cubic feet of natural gas in the last few months. The reduction of this leakage, which has been effected principally in Cowley County, Kansas, but also in Missouri, has been one of the factors responsible for better gas pressure of the entire companies this winter. The leakage reduction is said to have amounted to 75 per cent. in some places.

The world's actual production of oil in 1918 was about 515,000,000 bbls. The possible production of Mexico during 1919 was 547,000,000 bbls. In 1919 Mexico was able to produce 32,000,000 bbls. more oil than was actually produced in all other countries in 1918, and 170,000,000 bbls. more than the U. S. production in 1919.

The American Gas Furnace Co. announces that its entire personnel will henceforth be concentrated in a main office in Elizabeth, N. J., in which city their two plants are located; also that the company has discontinued selling operations through their former sole agents, Messrs. E. P. Reichhelm & Company, Inc.

The Roumanian oil industry is being placed by statute under the control of a company under Government supervision. Fifty per cent. of the company's shares are to be held by the producers, 30 per cent. by the Government and twenty per cent. by consumers. The most modern machinery will be installed.

A prominent merchant of Boston has made what is believed to be a world's mileage record on a set of tires. He traveled 39,152 miles of steady, hard driving without a puncture, blowout or other trouble.

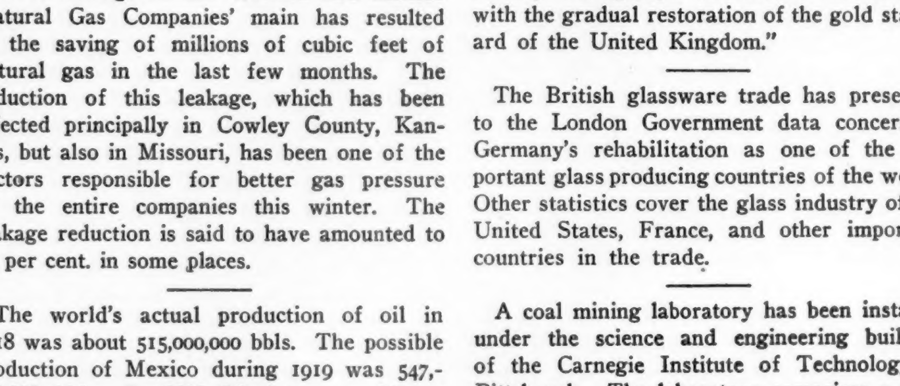
"My chauffeur advised me, he said, what make of tires to buy. When I followed his suggestion he took an interest in demonstrating that his judgment was good. When I sold the auto a short time ago, the tires had about finished their usefulness, but they had covered the 39,152 miles."

At the forthcoming summer Conference of Ministers of the British Dominions, according to the Whaley-Eaton Service, a proposal for the stabilization of the Inter-British Empire exchanges will be considered. It is stated that care will be exercised to impress the world with the fact that whatever emergency remedy is adopted, it will not be "inconsistent with the gradual restoration of the gold standard of the United Kingdom."

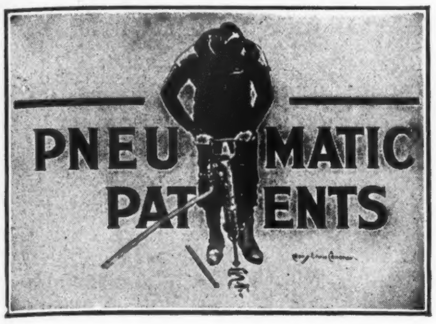
The British glassware trade has presented to the London Government data concerning Germany's rehabilitation as one of the important glass producing countries of the world. Other statistics cover the glass industry of the United States, France, and other important countries in the trade.

A coal mining laboratory has been installed under the science and engineering building of the Carnegie Institute of Technology at Pittsburgh. The laboratory comprises a full-size coal mine, a mine locomotive and a complete set of coal and metal mine machinery, furnished by various manufacturers.

It is reported reliably that the decision of Belgium to open negotiations with the United States looking toward an exchange of raw materials for finished Belgian goods, and the dispatch of a delegation to bring about such an arrangement, contemplates negotiations with private American merchants, under Government sanction.



AS IT WAS TOLD BY THE COMPRESSOR.



United States

JANUARY 4

1,364,082. COMPRESSOR. Edward R. De Luiz, Detroit, Mich.
1,364,142. RAISING SUNKEN VESSELS. Jesse W. Reno, New York, N. Y.
1,364,165. PNEUMATIC RIVETING HAMMER. John Howard Way, Philadelphia, Pa.
1,364,246. COMPRESSOR. John O. Carrey, St. Louis, Mo.
1,364,294. PNEUMATIC SPRINGING OF VEHICLES. Frank Smedley Farnsworth, county borough of Derby, England.
1,364,337. DIVING-BELL. Manley A. White, Beverly, Mass.
1,364,340. SPRINKLER SYSTEM. Wylie G. Wilson, New York, N. Y.
1,364,360. BLOWER. Charles W. Emery, Philadelphia, Pa.
1,364,404. CARRIER APPARATUS. Theodore W. Nygreen, Bellingham, Wash.
1,364,500. POWER - OPERATED VACUUM MASSAGE APPARATUS. Harvey L. Hopkins, Chicago, Ill.
1,364,532. FEEDING DEVICE FOR PULVERULENT FUEL IN FURNACES. Karl Hjalmar Vilhelm von Porat, Stockholm, Sweden.
1,364,554. SUCTION - SWEEPER. Howard Earl Hoover, Chicago, Ill.
1,364,596. PNEUMATICALLY - REINFORCED CASING FOR AERONAUTIC CARRIERS. Nathaniel B. Wales, New York, N. Y.
1,364,619. TIDE-POWER APPARATUS. Pillsbury C. Dolliver, Medford, Mass.
1,364,646. AIR-BAG AND SALVAGE METHOD FOR RAISING SUNKEN VESSELS AND OTHER OBJECTS. Alfred Ryan, Oldham, England.
1,364,670. COTTON-PICKER. Joseph V. Wofford, Catoosa, Okla.
1,364,690. AIR-TRAP. John H. Bledsoe and Martin Hauser, Kansas City, Mo.
1,364,761. SUCTION - CLEANER. Howard Earl Hoover, Chicago, Ill.
1,364,796. BLOWER-FAN. Thomas E. Ogle, Kansas, Ill.
1,364,810. METHOD OF AND MEANS FOR INCREASING THE OUTPUT OF POWER OF ENGINES OF AIRCRAFT. William Colin Russell, East Sheen, Surrey, England.

1. In an aircraft having a driving engine and a super-charging system comprising a pump, a conduit leading from said pump and communicating with the induction of the engine whereby air compressed by the pump may be conducted to the engine, a prime mover operable independently of said engine for operating said pump, and means responsive to variations in the pressure of the air in said conduit to control the speed of the pump.

JANUARY 11

1,364,972. BLOW-TORCH. James B. Anderson and Charles H. Allen, Pittsburgh, Pa.
1,365,064. MILKING-MACHINE FOR COWS. Warren A. Shippert, Chicago, Ill.
1,365,112. CONTROL FOR MOTOR - VEHICLES. George F. Line, Muncie, Ind.
1,365,206. HOT-AIR MOTOR. William J. H. Strong, Chicago, Ill.
1,365,210. AIR-LIFT. Ralph H. Tucker, Los Angeles, Cal.
1,365,272. UNLOADING DEVICE FOR AIR-COMPRESSORS. Charles H. Reeder, St. Louis, Mo.
1,365,273. AIR-LIFT PUMP. Charles P. Ringler, Elmhurst, N. Y.
1,365,284. HUMIDIFYING-VALVE. John W. Shepherd, Andrews, Ind.
1,365,359. WATER-SUPPLY SYSTEM. John Henry Valle, Dayton, Ohio.
1,365,422. AIR HEATER AND DRIER. John A. Meroney, San Francisco, Cal.
1,365,459. BLOWER DEVICE. Peter Comina, Aptos, Cal.
1,365,462. METHOD AND APPARATUS FOR MANUFACTURING INFLATED RUBBER ARTICLES. Neil D. Crawford, Milford, Conn.
1,365,506. COMPRESSOR. George F. Krieger, Grand Rapids, Wis.
1,365,571. STORAGE - HOUSE AERATING SYSTEM. Robert B. Vaughan and Ralph M. Love, Dallas, Tex.
1,365,606. PNEUMATIC OR LIKE ROLLER. Alfred Seymour-Jones, Wrexham, Wales.
1,365,639. METHOD OF AND APPARATUS FOR THE PRESERVATION OF BODIES AFTER BURIAL. Vincenzo Branciforti, New York, N. Y.

1. A method of preserving bodies after burial, which includes placing said body in a sealed container together with a substance adapted to react with the moisture in the air of said container so as to generate a preservative gas under pressure, the pressure of said gas being adapted to force liquid preservatives into said body.

France

Second list of French patents inserted in the "Bulletin Officiel De La Propriete Industrielle Et Commerciale" for 1920.

501,683. Societe dite: Mann Egerton and Co., Ltd. Improvements in rotative air and gas compressors.
501,560. Dumanois (E. P.). Air compressor for starting gas motors.
501,561. Dumanois (E. P.). Air distributor for gas motors.
501,687. Societe Leflaive & Cie. Improvements in riveting pneumatic hammers.
501,983. Bottle making machine.
502,231. Michel (A.). Pneumatic screw-jack.
502,063. Artturi Somersalo Ja K: T. Improvements in couplings used for air pipes in railway-cars.
500,384. Compagnie Belge - Goliath (Societe Anonyme). Improvements in valve distribution for pneumatic tools.
500,385. Compagnie Belge - Goliath (Societe Anonyme). Rotating device for pneumatic hammers.
500,324. Mc. Gregor (W), Societe dite: Fuller - ton Hodgart & Barclay, Ld. Improvements in air compressors.
500,219. Beraud, P. Apparatus for glass blowing.
500,442. Galey (J. E.) & Mme. Galey, nee M. C. Sevin, 59 Avenue La Bourdonnais, Paris. Air filter.
500,640. Societe Leflaive & Cie. Pneumatic hammer.
500,685. Societe dite: Quigley Furnace Specialties Co. Conveying device for coal powder by the use of compressed air.
500,722. Vermersch (A.). Nipple to use compressed air for gasoline motor.
500,868. Societe dite: Kellogg Manufacturing Co. Improvements in air pumps.
500,972. Poitevin dit Potavin (E. X. P.) a Olonzac (Herault). Nipple for hose.
500,985. Societe dite: Fours et Procedes Mathy (Societe anonyme). Bottle-making machines.
501,077. Societe Bardot et Verboom. Blowing machine for glass industry.
501,172. Cantillon (J.). Improvements in air compressors for air brake.
501,082. Rogers (E. M.). Air lift.
501,088. Societe dite: Quigley Furnace Specialties Coe. Conveying device for coal powder by the use of compressed air.
501,455. Buluze (C.), Langenieux (L.) & Pelosse (L.). Compressed air apparatus to drive shuttle in weaving gins.

In Germany

59b (2). 326,866 of November 25th, 1919. Arthur Pangert, Leimbach. Air suction device for centrifugal pumps.
87b (2). 327,455 of April 12th, 1919. German Engineering Works (Deutsche Maschinenfabrik) Duisburg. Device for the gradual starting of compressed air tools.
87b (2). 327,456 of April 18th, 1919. Hugo Klerner, Gelsenkirchen. Valve gear for tools actuated by compressed air.
47g. 30. F.47,031. Frankfurter Maschinenbau-Gesellschaft, Pokorny & Wittekind, Francfort-on-Main. Piston for pressure regulator. 12.6.1920.
74g. 12. Sch.57,413. Dr. Engineer Kurt Schoene, Hamburg, Adolph street, 74. Valve for pumps and compressors with nozzle shaped extension of India rubber or similar material. 4.2.1920.
5b. 756,176. Emil Baingo, Laurahutte, Silesia. Exchangeable flat steel coal drill bits with appertaining shaft. 20.9.1920. B.89,584.
46d. 755,889. Joseph Marcus, Dusseldorf, Kaiser Wilhelm street, 36. Compressed air motor with unbroken piston rod not fastened to the spring wheel. 4.10.1920. M.67,374.
46d. 756,284. Michael Borkowski, Buer-Erle, Westphalia, Compressed air machine. 8.9.1919. B.84363.
5b. 755,187. Hermann Schmidt, Neu-Salzbrunn near Waldenburg. Suspendable coal-cutting device for rock drills. 3.5.1920.
46d. 755,239. Joseph Marcus, Dusseldorf. Compressed air motor with automatic valve gear. 20.9.1920.
46d. 755,594. Otto A. Jurischka, Gusten, Anhalt. Continuous compressed air power machine. 3.3.1920.

WILLIAM HUEY LOVEGROVE

William Huey Lovegrove, of the Tennant-Lovegrove Company, consulting engineers and agents of the Ingersoll-Rand Co., Houston, Texas, passed away recently at the age of 60, after an illness of two months. A resident of Houston for fifteen years, Mr. Lovegrove was widely known in and had been prominently associated with the compressed air machinery industry of the South. He had been instrumental in establishing many of the large irrigation and reclamation projects of Southern Louisiana and Eastern Texas and had a large circle of friends among engineers, public officials and industrial executives. He was particularly widely known among oil men of Texas, Louisiana and Oklahoma. Mr. Lovegrove founded his Houston concern under the name of the W. H. Lovegrove Company, which subsequently became Randall, Lovegrove & Wyman, then Randall-Lovegrove and finally the Tennant-Lovegrove Company, the founder remaining as the active head of its affairs almost up to the time of his death. It is understood that this thriving and prosperous business will be carried on as usual by Mr. J. A. Tennant, an able sales engineer. Mr. Lovegrove is survived by a widow, Mrs. Sophie H. Lovegrove; a son, Stanley D. Lovegrove; two brothers, Thomas G. and James Lovegrove, and a sister, Mrs. Mary Lower, all of Philadelphia.

THE MOSQUITO-MALARIA CIRCUIT

Malaria is caused by parasites in the blood, according to H. R. Carter, Assistant Surgeon General, U. S. Public Health Service. These parasites are injected into the person by the bite of a mosquito, of the germs Anopheles, infected with the parasite. Man receives infection in no other way. The mosquito receives infection by feeding on a person whose blood contains such parasites. The mosquito acquires infection in no other way. The change from man to mosquito and back again is necessary for the continuous existence of the parasites. The malaria parasites can not live indefinitely in the mosquito or in man. For malaria control therefore:

(1) Keep infected mosquitoes away from man, or

(2) Keep mosquitoes away from infected men.

Get rid of either the mosquito or the man and malaria will be eliminated.

Edward Steidle has prepared for the Bureau of Mines of the U. S. Department of the Interior a treatise now issued in pamphlet form, entitled, *Causes and Prevention of Fires and Explosions in Bituminous Coal Mines.* Criticisms of this circular are invited. The chief aim of the Bureau of Mines is the elimination of accidents and the preservation of life, and the bureau hopes that this illustrated circular and others to be published in future will be of service to all miners. The pamphlet sells at 20 cents.

AIR PRESSURES AND DRILLING SPEEDS OF HAMMER DRILLS*

By H. W. SEAMON

THESE DATA were collected during a series of tests made at the property of the United Verde Copper Co. to determine the most economical air pressure for the operation of hammer drills under the varying conditions of use, and to investigate the variation in drilling speed at different air pressures. About 1,500 tests were made on twelve models of drills, at gage pressures ranging from 40 to 130 pounds. No effort was made to bring theory and practice into accord; but rather to formulate sundry empirical rules covering the average variation of the results obtained. However, these rules on the performance of hammer drills, based on the air pressures as the main variable are not necessarily of universal application; they apparently satisfy the results obtained in this particular series of tests.

The drilling conditions at this property vary widely. An average of 21 machine shifts to a 3-ft. round is necessary in some of the development work; while an advance of 56 ft. has been made in seven shifts in the "oxide" ground. This wide range of conditions precludes the adoption of one type of drill as a standard; consequently almost every kind of hammer drill sold in this country has been tested during the past few years. At the present time, sixteen different models of drills are in use, of which two types of the heavy (150 to 160 lb.) mounted drills, one of the light mounted drill, one stoper and two-hand plugging drills are considered as standard.

Inspection of the several tabulated results shows that:

1. There is little or no increase in mechanical efficiency of the drills above 90 lb. pressure.

2. The distance drilled per air indicated horse-power is a maximum for the jackhammer type at 90 lb. and increases at a slow rate for the other machines at the higher pressures.

3. The average thermal efficiency is a maximum at about 95 lb.

4. The factor of desirability, while increasing as the pressure, shows a comparatively slow rate of increase for pressures above 100 lb.

5. The average drill is made to be used at a pressure of 80 lb. or less, and the use of pressures much exceeding this would invalidate the present replacement agreements with the manufacturers, thereby increasing the upkeep cost.

6. The increased breakage at the higher pressures, with the consequent greater loss of time of the drill runner in changing or repairing the machine, would tend to reduce the factor of desirability.

7. The increased breakage of drill steel would tend to limit the pressure, although there are not sufficient data on this point to determine the maximum.

From the foregoing, it would seem that under the conditions obtaining at this property, about 95 lb. is the most economical gage pressure.

*From a paper presented at the February, 1921, meeting of the American Institute of Mining and Metallurgical Engineers.

THE GYROSCOPE

The gyroscope for vessels is being used on so many ships according to *Ingenerio International*, that a sailor of the steamer *Henderson* suggests that they furnish one of

proper size to carry in the pocket of each sailor so that he can return to his ship after being on shore.

For a World's Fair in London in 1922

Announcement is made of a world's industrial exhibition, to be held at the Crystal Palace, London, during the months of May to October, 1922, of the industries, products, arts, sciences and inventions of the leading manufacturing countries of the world. It will be on a coöperative basis, the capital being provided by the exhibitors and those otherwise connected with the exhibition (such as the guarantors of each nation who guarantee sufficient for the preliminary work connected with the exhibition of their nation), and the profits accruing from the various sources of revenue, such as contracts for advertising, catering, amusements, season tickets, gate receipts, etc., will be apportioned pro rata among the exhibitors in order to bring the cost of exhibiting to the lowest possible figure.

Each country will elect its own exhibition committee, which in turn will be represented on the general committee. The management will be under the control of a committee representing the exhibitors and guarantors generally. More definite particulars with names and addresses of officials may be looked for in the near future.

We have received from the Department of Labor and Industry of the Commonwealth of Pennsylvania, of which Mr. Clifford B. Connelley is Commissioner, its Bulletin No. 8 of Vol. VII, containing the report on the activities of the Bureau of Inspection in assisting the industries of the Keystone State in returning to a normal pre-war condition. Both national and state organizations which have been carrying on similar work will find much of interest in this report.

THE BLUE SKY AND THE OPTICS OF THE AIR

By LORD RAYLEIGH.

WHEN LIGHT passes through the atmosphere it is acted on by the molecules of the gases present. The longer waves pass through with little change, so that the transmitted light is rich in red and yellow. Thus the vivid colors of sunrise and of sunset are accounted for. The short waves, on the other hand, are scattered laterally and in this way blue light comes from the group of illuminated molecules. Soapy water or dilute milk is yellowish by direct light but appears bluish when viewed from the side.

A thick layer of ozone absorbs such wavelengths of the light that traverse it that the emerging light is blue. This has led to the theory that this gas is responsible for the blue of the sky. No doubt it may contribute in a slight degree to the effect, but that it is not the predominating cause is shown by the redness of sunsets. At this time of day the length of the path of air traversed by the light is at a maximum and the absorption by ozone is likewise at its maximum, but the colors we see are by no means blue. Nor can absorption by ozone account for the polarization of light from the sky.

Ozone does, however, leave its hall-mark on the light which reaches the earth from the sun. The lecturer, to prove this, showed the following experiment, never before exhibited to an audience. By means of lenses and prism of quartz the spectrum of light from an iron arc was formed. The presence of the ultra-violet spectrum was demonstrated by placing a screen of barium platinocyanide beyond the violet end. The ultra-violet rays made this glow with green light. A glass tube six inches long was put in the path of the light before it was dispersed. When oxygen that has passed through an ozone generator flowed through the tube then that part of the spectrum due to the light coming through the tube was seen by the audience to lose most of its ultra-violet part. This again appeared when oxygen alone flowed through the tube. The gas from the ozone generator has less than 1 per cent. of this constituent in it, yet it cuts off the spectrum at about 2900 angstroms. The spectrum of sunlight shows the absence of the same wavelengths. Detailed comparison of the spectrum of sunlight after it has passed through the atmosphere of the earth with the spectrum of the light of the iron arc after traversing a body of ozone shows that the absorption bands are the same in both cases and the conclusion is justified that the brevity of the ultra-violet spectrum of sunlight is due to absorption by ozone in the atmosphere.

There is scarcely any ozone near the surface of the earth. This was proved by the examination of light from a terrestrial source after it had passed through four miles of air. There was no evidence of absorption due to ozone.

The tenuous ozone of the upper air, little known and inaccessible as it is, plays an important part in the life of man by abstracting from the sunlight the ultra-violet rays which the human eye could not endure.

*From a lecture at the Royal Institution.

IV

IE

at-
cules
pass
rans-
Thus
are
other
way
nated
yel-
when

wave-
t the
the
blue
in a
s not
red-
ength
s at a
like-
are by
ne ac-
e sky.
rk on
e sun.
ollow-
to an
sm of
on arc
-violet
screen
et end.
with
g was
as dis-
rough
e tube
e light
he au-
t. This
flowed
ne gen-
is con-
rum at
of sun-
wave-
ectrum
the at-
of the
body of
are the
s justi-
t spec-
y ozone

surface
exami-
ce after
There
ozone.
r, little
an im-
tracting
s which

tion,